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ROY V. WRIGHT, *Editor*
R. E. THAYER, *Associate Editor* C. B. PECK, *Associate Editor*
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Engine House Competition Prize Winner

The prize for the best article on engine house work submitted in the competition which closed July 15 has been awarded to R. G. Gilbride, locomotive foreman, Grand Trunk Pacific, Graham, Ont. A number of contributions were received in the competition and most of them have been accepted for publication. The judges considered that Mr. Gilbride's paper possessed the most merit from an all around engine house standpoint. The article will be published in the September issue.

Instructing Men on Safety Appliances

It was brought out in the discussion on safety appliances at the Master Car Builders' convention in Atlantic City in June that considerable trouble has been experienced in getting men to understand the proper application of these devices. At one point on a large eastern road there has been little or no difficulty of this kind. It has been avoided by calling the foremen together and giving them careful instructions on the rules regarding safety appliances and their application to cars. At these times the foremen naturally brought up any questions which had proved puzzling to them and these were gone over by the entire staff and explained so that there was no further misunderstanding. The foremen, then having a thorough understanding of the appliances, made good use of this knowledge in instructing their subordinates. As a final precaution, each car that is equipped with safety appliances is carefully inspected by a committee of four foremen before it leaves the shop; errors made in the application are not likely to escape detection by some member of the inspection committee. This has proved to be the fact and almost no trouble has been realized in applying safety appliances at this shop.

Mechanical Department Convention Reports

The Air Brake Association has established a record this year in placing the bound volume of the report of its 1914 convention in the hands of the members about two months after the association convened, and at the same time has included in this report the list of subjects and place of meeting for the 1915 convention. The association is to be congratulated on the despatch with which this work has been accomplished; it surely will be greatly appreciated by all the members. Every other similar association should make a strong effort to follow this example. The secretary of the Air Brake Association has been greatly assisted by a resolution passed by the executive committee to the effect that, if after three weeks from the time the remarks of the various members are sent to them for correction no reply has been received, the secretary be empowered to use the original remarks as reported by the stenographer in the final published volume of the proceedings. The Master Boiler Makers' Association, which held its annual meeting the latter part of May, has been equally as prompt in issuing its proceedings.

The Relations Between Foremen and Men

In an address delivered before the International Railway General Foremen's Association, at the convention held in Chicago last month, A. P. Prendergast, superintendent of machinery of the Texas & Pacific, stated that he had always found a large proportion of railway employees prone to follow their leader. A foreman who does not conduct himself in a manner that will set a good example for the men under his jurisdiction need never expect to obtain a very great hold on their respect, and without it he will not be able to build up a very successful organization. It is not intended to suggest that a foreman should hold himself aloof from his men; on the contrary he should keep in close touch with them, not with the idea of looking for mistakes for which they should be censured, but in order to encourage them in their work and

to study their personalities. Much is to be gained in shop efficiency by assigning men to work which they like and for which they are especially fitted, and what branch of work this is can only be learned by close personal study of the individual. Any one who is engaged in a supervisory capacity should take pains to see that all reasonable steps are taken toward providing for the bodily comfort of the men. Not only is it due to the workmen to make their working conditions as pleasant as possible, but it will be found to tend greatly toward increasing their efficiency and toward perfecting the organization. The railway officer who believes that the only way to get work out of men is to drive and ill treat them is hopelessly out of date and should have no place in any present day railway organization.

Tool Foremen's Convention

The tool foremen at their recent convention maintained their previous good record in regard to attendance and thoroughness of discussion. Considerable information was given to the association by the different members, the best points of which covered the use of spiral reamers, and milling machine practice. The spiral reamers, when properly made, have effected marked reductions in the cost of reamers and at the same time have provided satisfactory results. By their use carbon steel can be used where high speed steel was previously necessary, and the workmen are provided with tools that do the work with such despatch and accuracy that it is a pleasure to handle them. That milling machine work is in its infancy, especially in railroad shops, is a well known fact; the possibilities are almost unlimited. From the enthusiastic discussion on this subject by Mr. Kinsey of the Illinois Central, the tool foremen have received suggestions that should bear fruit during the coming year.

The railway tool foreman is perhaps the greatest efficiency expert in a railway's shop organization. He is in a position to save the road by whom he is employed considerable money by providing tools in such a condition that they will require the minimum amount of power and labor to operate them, by providing special tools that will decrease the time required to do the various jobs, and by so designing and tempering the tools that they will give a good amount of service. He is an important man in the shop and should be given every opportunity to keep in touch with the progress in the art of tool making.

The College Man and the Railroads

Once again the ever important subject of the college man and the railroads demands our attention; this time in the form of a communication which will be found on another page. In developing and fitting himself for a career, can the college man afford to think of the compensation which will accrue to him during the early years of his service on the railroad? Surely this should not be deserving of very much weight during the first four years after leaving college. During this time it is vitally important to establish a right foundation, and this can only be done by beginning at the bottom and getting into intimate touch with the rank and file and with the minor details of the work of the department which the young man intends to follow. Experience, and particularly experience in studying the human element and its handling, are the important things. The amount of compensation is relatively unimportant. The danger is not in advancing too slowly, but rather in being advanced too fast and thus missing an important part of the experience which is to be capitalized in the future.

Our contributor compares the compensation of a special apprentice on a railroad at the end of four years' service with that of engineers who have gone into other fields of work and suggests that it is one reason why college men leave railroad work. Is this a fair conclusion? Or if the men do leave railroad work for this cause, is it not a serious mistake on their part? What would the results be if a similar comparison were made at the end of a period of ten years and proper allowance was made for the difference in the cost of living at the points where the men were located, the advantages to the railroad employee of free transportation and the greater variety of the work in this field? It is true that railroad work has its disadvantages. It is also true that railroad officers, and particularly those in the mechanical department, are not as well paid as they should be; many of the mechanical department officers and foremen are very much underpaid and are deserving of far better salaries than they are receiving; but this is also true in many instances of men who are engaged in other fields of engineering.

The college graduate, when he enters railroad service, is a rather one-sided proposition. He may have the theory of engineering down ever so fine, but he is lamentably weak in practical experience and in the understanding of the human element. It takes him years to broaden out and to secure a proper balance, and he cannot expect to receive very large financial returns for the first few years of his service. The wise professor will send his men forth fully impressed with their lack of these essential features and with the knowledge that several years of strenuous application and hard work will be necessary before the handicap can be overcome. This handicap is greater in these later years on those roads which have thoroughly installed modern apprenticeship systems and are closely following them up in order fully to utilize the splendid material which is developed by these methods.

Resourcefulness Needed in Engine House Work

A college graduate, who has held the position of engine house foreman, stated recently that it was quite a little time after his appointment to the position before he finally realized that fixed lines of procedure are not followed to any great extent in making running repairs to locomotives. His college training had not appreciably shown him the need for following any but previously tried practice; in fact he graduated with the idea pretty well fixed in his mind that most mechanical engineering work follows lines of procedure that have been carefully tried out and proven. Most of his shop work experience was gained in a repair shop of considerable size where he saw such work as the lining of guides, the lining of shoes and wedges, etc., carried out in much the same way on every engine that went through the shop. Consequently, when he was placed in charge of an engine house he was the cause of numerous engine delays and much heated correspondence before he awoke to the fact that back shop methods cannot always be followed in making running repairs.

It is unfortunate that some of our colleges do not make greater endeavors to develop resourcefulness in their students. The course being followed by the students of the transportation course at McGill University, Montreal, should tend, to a considerable extent, to accomplish this. This course has been very carefully developed under the direction of Professor H. O. Keay, who is in charge of the transportation department, and is being carried out in conjunction with the Canadian railways. The general manager of the eastern lines of the Canadian Pacific has recently issued a circular prescribing the course which the transportation students are to follow in obtaining their practical experience. This extends over the vacation periods of the college course and also over a considerable period after graduation, and regardless of what branch of railroad work the student intends to follow, he is assigned for a certain length of time to work in each department. Thus it may be readily seen that any one who intends following the work of the mechanical department must have considerable knowledge of engine house conditions, as he is assigned not only to a certain amount of engine house work, but also to work in the operating department, both on the road and in the yard, which brings him in direct contact with the engine house and should give him an insight into engine house conditions from the operating stand-

point, something which should prove invaluable to him later if he is placed in charge of an engine house. An engine house foreman who has assisted the yardmaster and the trainmaster in making up trains and in getting them over the road will not be likely to employ any repair methods which will delay a locomotive longer than is necessary.

Another Car Department Competition

The draft gear competition, which we recently held, developed some splendid information which should prove of great value in solving this troublesome problem. Undoubtedly the difference between a good and a bad draft gear is very noticeable in keeping the entire car in better physical condition and in protecting the lading from damage, particularly in the case of house or box cars. Leaving the draft gear out of consideration, what in your opinion is the greatest defect in box cars and how can it be remedied? The Railway Age Gazette a year or two ago published a series of articles on defective box cars and damaged freight. Since that time a very considerable advance has been made in so improving box car design and construction, and in so maintaining the cars, that greater protection is afforded to the lading. In spite of all the efforts which have been made, however, the surface has only just been scratched and there is still a considerable field for constructive criticism along these lines. Then, too, comes the question of the cost of maintenance, the time out of service for repairs, the cost of hauling excess dead weight and features of this sort. With a view to focusing attention on these things and of developing a better understanding of the defects of box cars and the remedies which should be applied, we announce a competition to close October 15, 1914, on defective box cars and how the defects may be eliminated. A first prize of $50 will be awarded for the best paper, outlining what in the opinion of the writer is the most important defect and giving suggestions as to how it may be overcome. The judges will base their decision on the practical value of the suggestions offered. Articles which are not awarded a prize, but which are accepted for publication, will be paid for at our regular space rates.

The Draft Gear Problem

Last month we published the first prize article and three others that were submitted in the competition which closed May 15. Four more contributions to this competition appear elsewhere in this issue. These articles very largely supplement those which appeared last month; there is little duplication. Among the four which are printed in this number are two which advocate the use of the spring gear. Mr. Pearce bases his conclusions on the service records of 888 cars which were repaired in the "home shops" during a period of 30 days. It is rather difficult to reconcile these figures with those which were presented by Mr. Fritts in his paper before the Central Railway Club last September and which were reproduced in our issue of October, 1913. In the absence of further information concerning the records cited in Mr. Pearce's article it is to be assumed that the difference in results may be due to a variation in the types of the friction draft gears used, or as to the methods of collecting the data. More exact information as to the detail methods of assembling these records and as to the types of friction draft gears used is needed to permit of a proper understanding being gained of the value of these statistics.

It is interesting to note that the two practical car men represented in this issue both advocate the appointment of committees to thoroughly investigate the subject from a practical standpoint. Mr. Hogsett emphatically urges the railroads of the South to get together and go to the bottom of the situation without fear or favor; this to be done by a committee having representatives from the various departments involved. It is to be hoped that his stirring appeal will be listened to and heeded. Mr. Bundy urges the appointment of a special committee of the M. C. B. Association; this because the committee on coupler and draft gear, as at present constituted, is overloaded with the great problem of developing a standard coupler. It is to be noted also that one of the contributors again emphasizes the importance of the type of draft gear as concerns coupler repairs. More complete data on this phase of the question might greatly affect the decision of the association in adopting a standard coupler.

NEW BOOKS

Master Boiler Makers' Proceedings. Bound in paper. 167 pages, 6 in. by 9 in. Published by the association, Harry D. Vought, secretary, 95 Liberty street, New York. Price $1.

This book contains the official proceedings of the eighth annual convention of the Master Boiler Makers' Association, which was held at the Hotel Walton, Philadelphia, May 25 to 28, 1914. It will be noticed from the dates that the matter of publishing the proceedings has been handled very promptly and credit is due those who have had it in hand.

Cambria Steel Handbook. Prepared and compiled by George E. Thackray, C.E., special engineer, Cambria Steel Company. Bound in leather. 513 pages, 4¼ in. by 6¾ in. Issued by the Cambria Steel Company, Johnstown, Pa.

This book is the 1914 edition of the structural steel handbook issued by the Cambria Steel Company and is too well known to require an extended review. This is the eleventh edition and contains most of the matter of the previous edition, which, however, has been revised to conform to present practice and considerable new matter has been added.

Some Engineering Phases of Pittsburgh's Smoke Problem. Bound in paper, 193 pages, 6 in. by 9 in. Illustrated. Published by the University of Pittsburgh, Pittsburgh, Pa.

This report was made with the view first of determining the conditions which exist in the Pittsburgh district and account for so much smoke there, and second to describe the methods of furnace construction and the existing mechanical devices, the employment of which aids materially in securing more perfect combustion of fuel and lessens the amount of smoke produced. The book contains a large number of half-tone illustrations which show very clearly in a comparative manner the conditions which exist in Pittsburgh because of smoke.

Link Motions, Valve Gears and Valve Settings. By Fred H. Colvin, associate editor, *American Machinist*. Third edition, revised and enlarged. Bound in paper. 101 pages, 4 in. by 6 in. Illustrated. Published by the Norman W. Henley Publishing Company, 132 Nassau street, New York. Price 50 cents.

This book has long been well known among mechanical men, and this revised edition will without doubt be greatly appreciated. It is written in a manner that makes it readily understood and considers the locomotive link motion, valve movements, the setting of slide valves and gives analyses by diagram. A chapter is devoted to modern practice showing what is being done in the matter of eccentric rod lengths, etc. The slip of the link block is also considered and a chapter on piston valves shows eight varieties of this type as well as valve bushings.

Engineering Manual. Published by the American Electric Railway Engineering Association, 29 West Thirty-ninth street, New York; enclosed in cloth binders. Pages 6 in. x 9 in. Illustrated. Price to nonmembers of the association, $3. Binders, $1 extra.

This publication is a compilation of the standards and recommendations adopted by the American Electric Railway Engineering Association and covers practically the entire field of electric railway engineering. The book is in loose leaf form and consists of 82 sections fully illustrated with diagrams and working drawings. The loose leaf form has been adopted in order that the standards and recommendations may keep pace with such changes as are made at the yearly conventions of the association. Separate sections may be obtained if desired.

COMMUNICATIONS

COLLEGE MEN IN RAILROAD WORK

New York, June 11, 1914.

To the Editor:

A few weeks ago 14 young men who graduated in 1910 from a leading eastern engineering college were seated in a restaurant in New York. The conversation turned to salaries, and each man submitted his salary. This was done in such a way that the man to whom any given salary applied did not become known. These men were not picked. They were merely classmates who were located in New York, and probably represented a variety of temperaments and degrees of ability, as well as lines of work. The minimum salary noted was $1,200 per year, the maximum $2,100, with an average of $1,540 per year.

A man who has finished his special apprenticeship of four years would only now be receiving about $1,000 per year; up to this time his salary would have been even less. His chances for advancement are hardly better than those of other young men. Perhaps this case illustrates one of the reasons why college men leave the railroads. Special Apprentice.

QUESTIONS FOR CAR DESIGNERS

Benson, Neb., July 15, 1914.

To the Editor:

In regard to the query of W. R. N. in the May issue, relative to the proper method of computing the bending moment at the corners of an open door frame in the side of a car for given conditions of shearing forces, the statements made by R. N. Miller in the June issue that the nature and magnitude of bending moment depend upon the manner of load distribution; that there are two general types of car construction, a center girder and a side girder type; and that the side door frame in a side girder type must be designed to carry its share of the bending moment in the side girder, are true in themselves but contribute little toward an answer to the question of W. R. N. His statement that the bending moment to be resisted by the door frame does not depend upon the vertical shear and that the shear serves only as a criterion of the bending moment, is not true. The proposition intimated by W. R. N. that the moment of forces tending to deform a side door frame may be computed from the shearing forces acting across that frame is true, and, so far as the particular problem given by him is concerned, the statement by Mr. Miller that the data given are incomplete is also true, but Mr. Miller failed to indicate what additional data were needed to solve the problem.

The use of the expressions by W. R. N. of "a downward shear on the right hand side of the door opening" and "an upward shear on the left hand side" indicate some confusion in his mind as to just what is meant by a shear. The shear on any section of a material is that condition of stress, the result of which is a tendency to slide the material on one side of the section relative to the material on the other side. Shear implies the existence of two equal and opposite forces, and we might have either one of two kinds on a given vertical section. First, the force on the right side may be acting upward and that on the left side acting downward; second, the force on the right may be downward and on the left upward. To distinguish these two kinds of shear we may arbitrarily call the first positive and the second negative. When W. R. N. speaks of an upward shear at one point and a downward shear at another I assume that he means that one is a positive and the other a negative.

Now let us compute the bending moment in the corners of a side door frame when we have the shearing forces. In the first place the shear at any section of a beam or girder is found by taking the algebraic sum of the forces (loads and reactions) acting on either side of the section. If in passing along a beam from one point to another there is a change in the shearing force there must be a change in loads between the two points, and if the shear remains constant there is no change of load. Suppose we have a door frame of width b between posts, and at a vertical section immediately to the right of the left hand post we have a positive shear S. Assume there is no load on the frame between door posts, then on the left of our assumed section there will be an upward force S which is carried upward by the left door post, and to carry our downward force S on the right side of the section we have nothing until we pass over to the right door post. For this condition we can say that the shear on any section between posts is S, and the moment tending to deform the door frame is $M = b \times S$. This moment tends to bend the frame at the corners.

Again suppose that between door posts there is a load P acting downward at a distance a from the left post. If the shear at the left post is S as before, at the right post it will be $S - P$. The bending moment to be carried by the corners of the door frame in this case will be $M = Pa + b\ (S - P)$. In the problem given by W. R. N. he has failed to give the location of the load, or loads, that cause the shear to change in passing from one post to the other.

For a condition of zero shear there are no distorting forces on the door frame and the bending moment of the side frame of the car at that point appears as simple tensile and compressive forces in the top and bottom members. C. H. Faris.

PACKING FOR SUPERHEATER LOCOMOTIVES

Chicago, June 13, 1914.

To the Editor:

Superheater locomotives do their best work when the engine crew knows that it is actually getting superheat, and the time is not far distant when every superheater locomotive will be equipped with a reliable pyrometer that will indicate to the engineman just how much superheat is being obtained. There is quite a difference in superheat obtained on different locomotives, even of the same class.

This brings us to the matter of a proper metallic packing, or, rather, a proper metal for metallic packing for superheaters. A packing metal that does good work on saturated steam locomotives will not answer on superheater engines. While the reverse may be true, it is not always economy to use a superheater packing metal for saturated engines. The tandem packing and equipment is what the writer would suggest as the most serviceable packing and equipment for use on superheated steam locomotives. The particular make or shape of packing, outside of being a very substantial body of metal, can in most cases be left to the will of whoever is in charge. The idea of the tandem packing is that better lubrication of the packing rings is obtained as the two sets retain some of the lubricant between them when the steam is shut off. The recommended practice is to use a copper-lead ring, or rings, in the first packing next to the cylinder, as this packing does most of the work, and is in the hottest place. A babbitt packing, preferably a metal containing approximately 80 per cent lead and 20 per cent antimony, should be used in the second set. This combination of metals is recommended on account of economy and also because of the fact that this combination will not wear the rods as fast as two copper-lead packings will. This combination has been and is being used very successfully where babbitt packing rings alone would not stand up. A curious condition found is the fact that many superheater locomotives are running with babbitt packings, many of them giving very good satisfaction. The writer is of the opinion, however, that where babbitt packing is giving satisfaction on a superheater locomotive they are not getting proper superheat, at least they are not getting the highest superheat possible, which, of course, is what the superheater is for.

Where single packings are used, on account of not having clearance enough to permit the use of tandem packings, the copper-lead packings will be found to be the best and the only ones that can be depended upon, and also in the end the most economical, even though the first cost is considerably higher. The use of a good swab and careful attention by the engineer to keep it well lubricated will make such a packing give a very good account of itself. It is also a pretty well established fact that engineers should leave the throttle cracked when drifting; for besides helping the packing it materially helps other conditions, such as the valves, etc., in keeping them better lubricated. In this connection, it might be pertinent to mention the fact that it will be a paying investment to keep close watch on vibrating cups, followers, springs, etc., in order that they will be in good condition at all times for a service that is very severe on packing at the best. A. E. M.

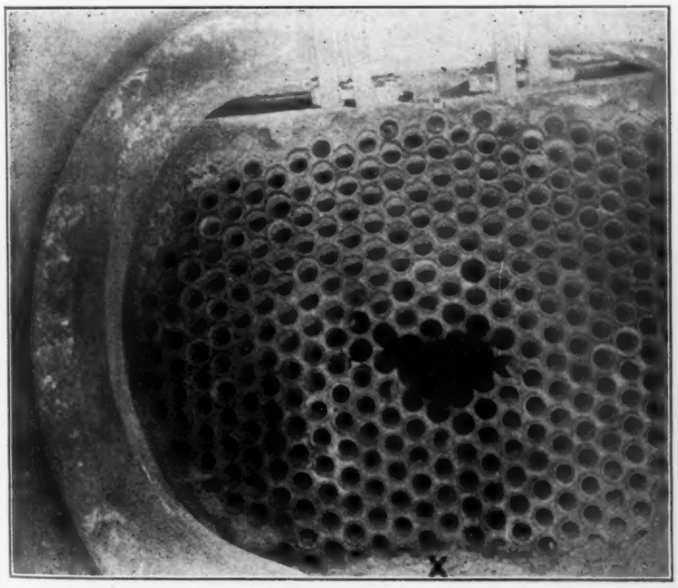
MELTED BOILER TUBES

[The following correspondence with the illustrations explains itself. We should be pleased to have any of our readers give the details of a similar experience, or to offer any other explanation of the phenomena than that found in the letter below.]

Mr. A. B. C———.

A consolidation locomotive was recently side-swiped in one of our yards and, on the next day, the following report was made:

"The running board, cab, brackets and main reservoir were torn off the left side, the guide yoke was bent and there were other minor damages; estimated cost $125."



X is molten metal

Fig. 1—Condition of Front Tube Sheet, Steam Pipes, etc., Before Stripping

The information I have was that this happened about 12:30 a. m. It tore some of the studs out of the boiler that held the running board, which caused the loss of water and steam from the boiler. The fire was knocked out of the engine as quickly as possible, and the night roundhouse foreman was notified. He stated that he went to the yard about 2 o'clock and found the fire out, and instructed that the engine be brought to the roundhouse. It was brought to the roundhouse about 3:30 a. m. and set on the cinder pit, and one of the cinder pit laborers notified him that the headlight exploded. He went to the engine as quickly as possible and found the front red hot, which was the cause of headlight exploding; he took the little front off and found everything red hot in the front end. He sparked the front and took the arch out of the firebox, but this did not seem to relieve the heat. He also put an iron plate over the top of the stack and left the firebox door open, thinking the engine would cool off.

About 6 o'clock in the morning he found the front end still very hot. There was no fire in the firebox nor ashpan, as the arch had been taken out, and there was nothing in the front end. As soon as the general foreman came on he called his attention to it, and as soon as the general foreman got to the engine he found the conditions as I have stated, but was afraid to put water in the front end.

Fig. 2—The Back Tube Sheet and Arch Pipes Were In Good Condition

I was called up about 8 o'clock and asked to come down to the roundhouse and look at the engine. I could not go down then, but went to the roundhouse at 12 o'clock noon, twelve hours after the accident happened, and found the flues still red hot; it had melted a part of the flue sheet and a great many of the flues entirely out, and the metal had run down in the front end and puddled. The total estimate of damage to the engine will be in the neighborhood of $1,200.

Fig. 3—View from Front After Front Tube Sheet Had Been Removed

This is a case that I have never seen anything like, and I am unable to explain what caused these conditions. This engine was sent to our shops for repairs and as the work of stripping the engine progressed we made photographs.

Our mechanical engineer and myself examined this engine and found that the greatest destruction wrought, due to overheating, was immediately back of the injector checks where a great num-

ber of the flues had been melted, as is clearly shown in Fig. 5.

Fig. 1 shows the front tube sheet, steam pipes, etc., before stripping. (The large hole shown in the center of the flue sheet was made so we could get some idea of what had happened inside the boiler and flues. Note the slag and melted steel from flues at *X*.)

Fig. 2 shows the back tube sheet and arch pipe, which were found in perfect condition. Fig. 3 shows the boiler from the front after the front tube sheet had been removed. Fig. 4 shows the interior of the boiler after the front tube sheet and all of the tubes had been removed. Fig. 5 shows the condition of the tubes just back of the injector checks. Fig. 6 shows a mass of tubes and solid matter taken from bottom of boiler just back of injector checks.

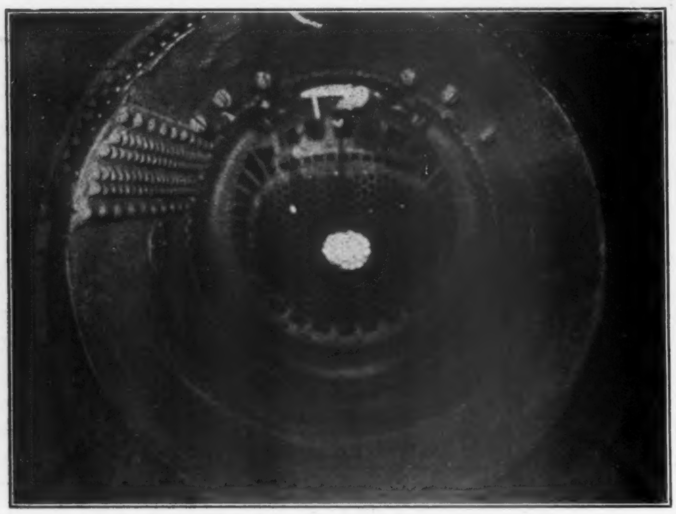
This is the second occurrence of this kind we have had in the past three years and we should be glad if you will tell us if you have ever heard of a case of this kind before and if you can say definitely what caused the damage.

X. Y. Z.,
Superintendent Motive Power.

Mr. X. Y. Z., S. M. P.

Perhaps the best way of answering your inquiry is to tell you of some other experiences.

A certain master mechanic had a lot of badly scaled locomotive boiler tubes. He had found that the scale was of such a nature



Bright Spot in Middle Is Open Fire Door
Fig. 4—Interior of Boiler After Front Tube Sheet and Tubes Had Been Removed

that it could be cleaned off by the application of heat, so he thought that he would make one grand job of it. He had them put in a pile and built a fire of oak ties beneath them. The fire was not hot enough to burn the tubes, but quite sufficient to remove the scale according to previous experiences.

He saw the fire lighted and went to his office; he had hardly taken his seat at his desk when a man rushed in and said that the tubes were melting. He went out and found that the fire was burning with ordinary brightness and not with any great intensity, but that, when he looked into the tubes, he looked into a glowing furnace at a white heat. The oak fire was pulled, but the tubes continued to glow and melt until they were quite destroyed.

The other case was that of a tug boat in New York harbor where the phenomena and conditions were very similar to those obtaining on your locomotive. The boiler had been emptied and the tubes were melted. The exact time required for the destructive action to take place I cannot give, but in all essentials it was a repetition of your experience.

Now for the explanation. There was a brick arch in the firebox that was hot when the fire was pulled. All of the heat that it radiated, in cooling, was picked up by the air as it flowed gently into the tubes on its way to the stack. Of course, this air was heated to a high temperature and contained the usual amount of free oxygen. There was possibly some soot or oxide of iron in the interior of the tubes, or some places where the tubes were quite bare. The high temperature of this oxygen enabled it to start an immediate attack on the exposed iron and set up a combustion of iron just as will occur in an oxygen bath. Of course, you are aware of the high temperature that would result from such a combination. But the products of the combustion of oxygen and iron are not gaseous as in the case of carbon and oxygen, but a solid, and so the heat generated by

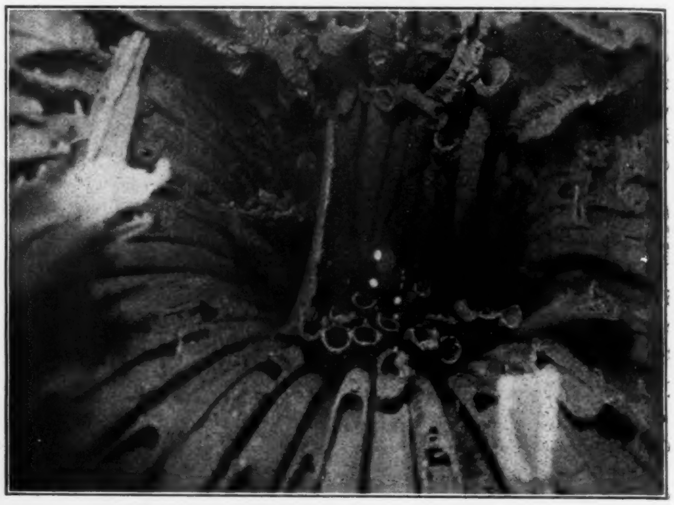


Fig. 5—Condition of Tubes Just Back of Injector Checks

the combustion was not lost by being carried away through the stack, but remained on the spot to add heat to that generated and the closing of the stack only made a bad matter worse by checking the draft and allowing only enough air to enter the tubes to keep up the fire.

I am inclined to think that this is an explanation of the phenomenon because the appearance of the tubes as they are shown in the photographs is so near like the appearance of the tubes of the first case cited that they could easily be passed off for the same. In that case there was no doubt of the oxygen-iron

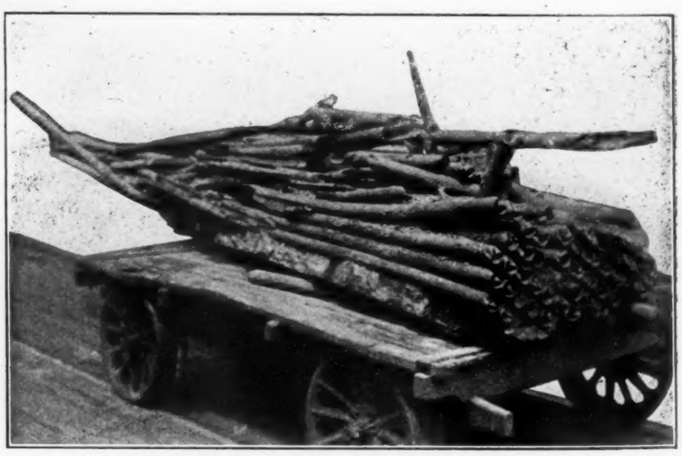


Fig. 6—Mass of Tubes and Solid Matter Taken from Bottom of Boiler Just Back of Injector Checks

combustion as it could be seen to persist even after the original source of heat had been scattered. In the case of the tug boat the appearance of the melted tubes was that of tubes that had been melted by burning, and you will probably find this to be the case with the tubes of your locomotive.

Of course, the obvious remedy will be to break down the brick arch whenever the fire is pulled on an empty boiler. The tubes could not possibly ignite unless there had been a previous source of heat and this was probably started by the heat from the arch.

A. B. C.

Draft Gear Problem And Its Solution

Second Series* of Articles on This Subject Which Were Contributed in the Recent Competition

A SOLUTION OF THE DRAFT GEAR PROBLEM

BY J. W. HOGSETT

Chief Joint Inspector, Fort Worth, Tex.

How many different departments on a railroad are affected by the good or bad performance of the draft gear, and from what viewpoints?

PURCHASING

The man in charge of purchases too often looks only at first cost, and if one device happens to cost ten or twelve dollars per car more than another the higher priced article is often turned down. At the same time he may have approved requisitions before him for a large number of couplers to be used in repairs. Unless his attention is called to it he would not associate the couplers purchased for repairs with the good or bad work of the draft gear. The purchasing officer should know that the draft gear offers its first relief to the coupler and its parts, as the shock is transmitted to the car through the coupler and the draft gear. If the gear is a good one the shock will not be as severe on either the car or coupler, hence fewer couplers will be needed in repairs. This applies to knuckles, knuckle pins, yokes, etc. Other requisitions may be on the purchasing officer's desk that could be reduced by the use of a good, instead of a bad draft gear; these include end sills, draft sills, siding and lining for replacing bursted ends, racked siding and roofing; even the life of metal roofs is dependent on the use of a good or bad draft gear.

If the executive officer, instead of commending the purchasing officer for saving five or ten dollars a car on the purchase of five or ten thousand cars, would look more to the purchases needed to keep the cars in service, better results would obtain. Of course the purchasing officer as a rule has no mechanical training, and it is hard for him to judge, but all roads have mechanical men that may be consulted, and by keeping a record of purchases needed to repair the cars it can very easily be decided whether the draft gear selected is good or bad.

THE MECHANICAL SUPERINTENDENT

The mechanical superintendent is affected by the use of a good or bad draft gear from the fact that he is interested in getting the greatest mileage and longest life out of the cars at the lowest cost. He should look into the design of the different gears submitted for his consideration to make sure that they are built along good mechanical lines. He should also see that they are applied in such a manner that the inspectors may see when they need attention, and when they do need attention in the way of repairs the work should be done at once. If the draft gear is kept in good condition a reduction in the damage to other parts of the car is sure to follow. That's what the draft gear is for. It is like a pair of shoes—you go out on a rainy day with shoes having thin soles or a hole in them; the result is wet feet, colds, sometimes sore throat or other troubles that make you buy "Rock and Rye" or pay the doctor. Moral: Make shoe repairs before you get wet feet. It is the same in purchasing; one kind of a shoe will wear only a short time before giving one wet feet; others will wear three or four times as long, but will not cost three or four times as much.

The same is true of the draft gear. There is so much to be lost by the use of bad draft gear that the mechanical man should spare no time in looking into the merits of the various devices available. Above all, the gears should be tested under a heavy drop hammer to see if they are shock destroyers, and if they are free from recoil. After they are in service, watch their performance; take them out occasionally and test them to see how long they will perform their work.

Get your superior officer to let you put on a few clerks to keep track of the total cost of car maintenance; not draft gear; breakages, because that is of no consequence. It is the other breakages that are causing your dollars to be wasted. Get to know something about the gears and car breakage—that's what mechanical men should do.

A few thousand dollars a year spent on clerks will give the mechanical superintendent information which will enable him to put his finger on the trouble spot and rub it out. With information of this character before him he is in position to administer the mechanical department economically, and the small amount spent on clerks will be nothing compared to the savings effected. If it does not show a saving then there is something else wrong. You may find that you have a man in charge of the mechanics that would make an excellent executive in some other line—a merchant, a farmer, a professor of science or some other walk in life. We are all good for something, but sometimes get misplaced.

CLAIM AGENT

Does the claim agent know that it is possible to strike a car hard enough to turn over a case or barrel of breakable goods, even when securely blocked, destroying the contents? Does he know that a hard blow causes grain doors to spring, shift and break, allowing the grain to spill along the right of way, producing a beautiful crop in the spring which never matures into anything but a loss?

Did you ever have stock knocked off their feet resulting in claims for damage?

Did you ever see a car struck hard enough to knock the end out, and then run it through a storm, wetting everything inside?

Do you know that cars that are constantly being pounded will loosen and tear the metal roof or covering so that the rain runs through into the car and onto the contents?

Do you know water is not good for flour until you are ready to make the bread?

Do you know water is bad for cement until you are ready to make the concrete?

Do you know this is true with everything shipped in covered cars, and that is why such shipments are made in covered cars?

You do? Well, do you know one kind of a draft gear not only does not relieve the car of these shocks, but produces a greater number and very severe ones on account of the recoil. I am not going to spoil the effect of my article by telling you that there is a draft gear that is a cure-all, that will destroy the effects of all shocks, but there is a great difference in the amount of work one kind will do as compared to another. The difference is so great that there are thousands and thousands of dollars to be saved by getting the right one.

THE GENERAL SUPERINTENDENT

Have you ever thought when looking over the morning business report, and finding that one of your most important passenger trains was delayed 30 minutes or more at some station on account of the freight train ahead breaking a knuckle, causing the train to part, and the shock due to the emergency application of brakes bursting the whole end of a weak car out, spilling the contents over the roadway, that if you had had a draft gear behind the coupler that would have lessened the shock on the knuckle, it would have prevented all this trouble?

This is a lot of trouble over a broken knuckle that only costs a couple of dollars, but can you give us the cost of the delay,

*The prize article and three others were published in the July issue, page 361.

the damage to air hose, the bursted car end, the loss of lading? The knuckle was a very small part, yet it started the dollars rolling into the sewer. Why? Because the draft gear failed to do its work.

Have you ever while riding over the line in the observation end of your business car noticed the coupler, draft gear, draft arms and part of the draft sills, all intact, lying along the track with draft gear in perfect condition? Did you stop to think that the car was broken by shocks the draft gear failed to destroy and the end pulled out in transit? You get along a little further and find the car pushed in on some siding waiting for repairs. How long will it be before that car is ready for service again, and how much will it earn while waiting for repairs?

No doubt the draft gear salesman could have pointed out with pride that his gear was as good as new, but look at the car. The draft gear cannot haul freight unless it has a car with it.

Have you ever been in a congested yard trying to hurry the freight out, hustling everybody and everybody doing all they could to assist you, with the engine waiting to couple onto the train as soon as the last cut of cars are put on; just about that time the switchman, in his great desire to help and honestly feeling that he was a part of the big railroad, and doing his little bit to help, cut them off and they ran down with a crash that broke a coupler? How did you feel? Did you pray, whistle, sing or swear?

Now just one claim—if the draft gear had destroyed the shock, the shock could not have destroyed the coupler. Where is the expense of this little damage going to stop? Have you ever noticed that certain stations have 200, 300, 500, 600, 1,100 or more bad orders, and that they may be 4, 5, 6, 8 10 or more per cent. of the total number of cars on the line? Have you heard the superintendent of transportation say that if such or such a shop could give a pull at noon and release 50 or more cars, he could supply the needs and save hauling empties from another division? Well, with all this before you, do you know that as much as ¾ or 75 per cent. of your damaged cars are due to the shocks they receive? Do you know draft gear should destroy shocks, and not the cars?

There is a wide difference between the amount of work various draft gears will do. I am not going to tell you which one will do the most, although I have very decided views on the question. You can find out for yourself—then go to it. I'll say this much—you must look among the friction types to find anything like efficient gears.

We have in a limited way referred to four departments that should be interested in getting the best draft gear: The purchasing officer, general superintendent, mechanical superintendent and claim officer, and can find no advantage in having anything but the best device. There are, of course, other departments affected. The treasurer can turn over more money for betterments if he does not have to spend too much for repairs. The traffic department can make a better showing and keep its patrons, if claims for damaged lading are kept down, if trains are moved promptly and on time, and if the equipment is always ready. The greater the number of damaged cars on hand, the more the resources are curtailed.

Inefficient draft gear simply means broken cars and inefficient equipment. Inefficient equipment means inefficient service. Inefficient service generally means that somebody is looking for another job.

There is only one place or one set of men on a railroad really benefited by bad draft gear conditions, and they are the men who repair the cars. The more broken cars, the more work for the repair men, and we all need work to make us happy. The question is, however, could not a whole lot more good be done with the same amount of money? I have not given any statistics for the reason that I have none. I am working in the dark, but the leak is so great I see the need for more thorough investigation.

WHAT IS TO BE DONE?

The questions I have asked are put in a respectful way and are not intended to be sarcastic. I have no intention of offending. We are having lots of trouble, the exact cost of which could be shown by more attention to repair records. What I would like to see would be a committee of say seven men appointed to investigate this question for the southern railroads.

Their instructions should be to get all the information possible fearlessly. Confer with draft gear manufacturers; confer with southern railroads. Make public the results of such investigation no matter who liked or disliked it.

On account of the main features being mechanical the majority of the committee should be from the mechanical department. This committee should be selected from different roads in the south and be composed of the following men: general superintendent, superintendent motive power, mechanical engineer, master car builder or general car foreman, mechanical department clerk, purchasing agent, claim agent. There should be an odd number on the committee. It would make the committee larger, but two joint car inspectors would be a splendid addition.

There would be plenty of work for the nine men and we would surely know by the time the report was made something more about the question than is generally known now. It is knowledge we want and not guess work. Men of the South, get busy, let us lead instead of follow.

WHY ATTEMPT THE IMPOSSIBLE?

BY MILLARD F. COX

Thousands of draft gear devices have been introduced, patented and discarded. More patents have been taken out on car couplings and car coupling devices than any other single device known. To say that there are a great many good draft gears is to err as badly as to declare there is only one, or to intimate there is only one designer.

The new heavy wooden car looked well when it first appeared. It chuckled to itself in the belief that with its deep center sills, braces and ties it would withstand terrific blows, and deliver deadly thrusts to the less fortunately constructed. But time went on, and these thrusts were noticeably no less in their frequency and violence, nor less destructive in their delivery. Our new friend became old and the glory in which it once reveled departed. Frequent shoppings brought it into disrepute until our twentieth century armoured iron clad put in its appearance, when we hoisted the distress signal and bade our once highly respected "heavy wood" adieu. With the introduction of the modern all-steel car, draft gear geniuses obtained a new lease of life. The subject freshened up considerably, and the "now we have it" became a very familiar phrase to many of us. Our "dreadnaught," without the slightest ceremony began immediately to poke itself not only at but into our old friend the "heavy wood," until it was unbearable. The "heavy wood" hitched up its trusses, tightened up its straps, pulled down hard on its bolts, buckled on reinforcements, set its brakes, and defiantly bid its adversary "come on." One sudden jerk of the hand at the switcher throttle, aided and abetted by the "iron clad," hunched our old "heavy wood" fore and aft. She doubled and plunged like the Hesperus, except as to "leaping her cables length"—nothing short of such a performance could have saved her even temporarily. In the fatal plunge we caught sight of the draft gear disappearing amid the splinters of our old friend. It was only another case of the "survival of the fittest."

Modern draft gear designers have kept abreast of the situation very well, and have achieved notable progress; much credit is due them. In spite of the abuse that is heaped upon them, the good draft gears make as reasonable a showing as any of the other attachments made and designed to break when strained beyond their limit. Who would have a gear that would stand more punishment than the car itself? Who would agree to make a

gear stand indefinitely the ramming and jamming of the modern Mallet or Mikado locomotives and their loads of iron clads? There must of necessity be a breaking groove somewhere in our cars, as on our engines, or else the "tail will wag the dog." Draft gears which are designed to gradually absorb the shocks, with the fewest number of pieces, with some flexibility to all of their members, are more than apt to give a good account of themselves. They have already shown a reasonable amount of efficiency. Heedless, headless ramming cars into each other, especially in the hump yard terminals, is the most discouraging thing with which draft gear designers and car repairers have to do. The cars are all-steel and can't be broken—let's see—and away goes the 100 to 150-ton ram against the draft gear. The new heavy wood is just as good as ever, but it was not built for such service. It cannot buck successfully such a formidable array, nor cope with such conspirators as a Mallet engine, all-steel cars, a reckless train crew, and the hump yard method.

I have been asked how long a locomotive will last. It is no harder a question than "how much punishment can a draft gear stand?" The modern hump yard method is the last conspirator in the list, but it is by no means the least of them. Take a train of 85 cars which I saw a few days ago; allow 6 in. slack to each, and we get more than 42 ft. in the total. These trip hammer blows are delivered regularly with each start and stop with deadly effect. The real wonder is that the gear is not destroyed sooner than it is.

The best draft gear, in my opinion, is the one that absorbs consistently all the blows it receives in regular service, distributing such as it cannot take care of to the underframe with the least possible amount of damage. The efficiency of the gear depends largely on the design of the car, which makes them interdependent and inseparably correlated. A good strong gear under a weak car is perhaps better than if this condition were reversed. The net results will be that in the first case the car will go to pieces, and in the latter the gear must be constantly renewed. In the light of these very plain practical facts, which many of us will readily recognize, why not adopt a rugged gear of moderate first cost, giving due consideration to design and construction of both car and gear, keeping in mind that the very best that can possibly be done will not withstand indefinitely the punishment the rigging is subjected to. A well designed spring gear, with springs of vanadium heat treated steel, and all other parts of a corresponding high grade material—the best of their respective kinds—will give results as satisfactory as it is possible to obtain, notwithstanding the voluminous and conflicting evidence to the contrary.

DRAFT GEAR PERFORMANCE

BY E. S. PEARCE

It will be the purpose of this article to set forth the demands made upon the draft rigging of a car, the means employed to meet these demands and to what extent they have been successful.

FUNCTION OF A DRAFT GEAR

There are two functions of a draft gear: First, to facilitate starting a train by aiding in overcoming the inertia of each car in the train. Second, to dampen or absorb the shocks due to the irregularities in the track, change of grade and a change of speed, or a combination of the two, or all of the above.

Inertia of the train.—The action which takes place in a draft gear at the instant the train is starting, may best be understood by the following simple experiments: If a small spring balance is attached to the leg of a chair and the balance is pulled an action similar to the following will be noted. First, with a steady pull the spring will be distorted an amount equivalent to the force necessary to overcome the inertia of the chair; after the chair has started to move the distortion of the spring will be decreased to an amount equal to the force required to keep the chair in motion. Second, with the force applied suddenly the spring will be distorted more quickly, and to a greater extent than with the steady pull. After the chair has started to move the action will be the same as in the first case. If, therefore, in starting a train, the starting force is quickly applied, a smaller initial rated tractive effort of the locomotive will be required than if the force is slowly applied. It is the purpose of the draft gear to assist in a sudden application of this starting force, and in so far as this particular function is concerned, the gear which absorbs the least amount of energy will prove to be the most efficient.

Absorbing and Cushioning Shocks.—Draft gears are called upon to absorb or dampen shocks which are received under the four following conditions of service:

1. Two cars meeting while running in the same direction at different velocities.
2. Two cars meeting while running in opposite directions, either at the same or different velocities.
3. One car meeting another car standing still.
4. One car with a given velocity meeting an immovable body.

Whether a car is being switched or is running in a train,

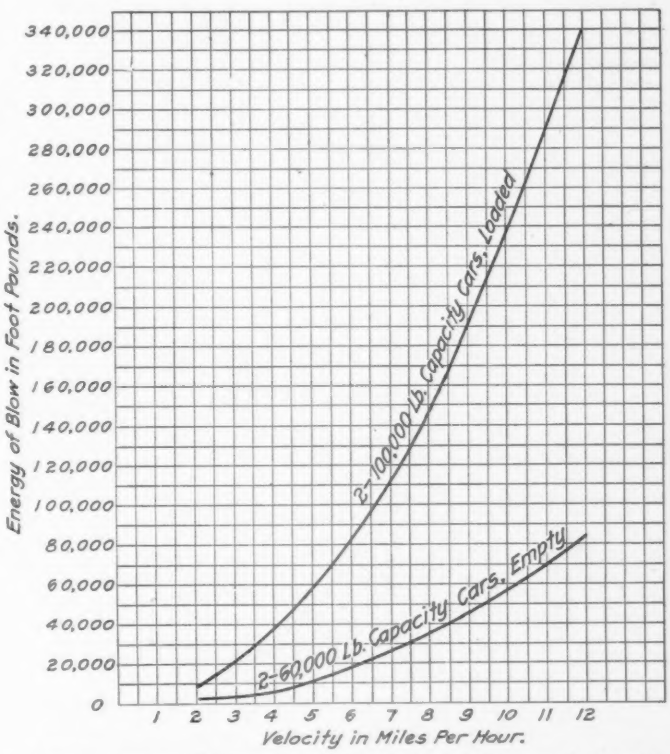


Fig. 1—Sum or Difference of Velocities for Conditions 1, 2 and 3

these four conditions will be met with. To obtain some idea of the magnitude of the blows delivered to a car subject to any one of these four conditions the curves in Figs. 1 and 2 are given. These show the blow delivered in foot pounds at various speeds, and were obtained by the use of the following formula as contained in the Proceedings of the American Railway Association of December 3, 1913, Appendix 5. The cars are considered as inelastic bodies and in the calculations a 100,000 lb. capacity steel car was assumed to weigh 43,000 lb. and a 60,000 lb. capacity car 35,000 lb.

Case 1. Two cars moving in same direction.

$$E = \frac{W \times W_1 (V - V_1)^2}{29.95 (W + W_1)}$$

In which

W = Weight of one car in pounds.
V = Velocity of one car in miles per hour.
W_1 = Weight of other car.
V_1 = Velocity of other car in miles per hour.
E = Energy of impact in foot pounds.

The energy of the blow delivered by two loaded 100,000 lb. capacity cars whose velocities differ by 2, 4, 6, 8, 10 and 12 miles are plotted as representing the maximum blows for these speeds; the energy of the blow for two empty 60,000 lb. capacity cars for the same difference in velocities is plotted to represent the minimum blows for the same speeds; these are shown in Fig. 1.

Case 2. Cars moving toward one another.

$$E = \frac{W \times W_1 (V + V_1)^2}{29.95 (W + W_1)}$$

The curves for Case 1 represent this condition with the exception that here the velocities plotted are the sum of the velocities of the two cars.

Case 3. One car standing still.

$$E = \frac{W \times W_1 \times V_1^2}{29.95 (W + W_1)}$$

Fig. 1 will also represent this condition, the velocity here being the velocity of the moving car.

Case 4. One car striking an immovable body.

$$E = .0334 \times W \times V^2$$

Fig. 2 shows the energy of the blow received by a 100,000 lb. capacity car, loaded and empty, also that of a 60,000 lb. capacity car loaded and empty, when striking an immovable body at speeds up to 12 miles an hour.

It will be seen from these diagrams that a maximum blow of from 80,000 to 340,000 foot pounds may be delivered to the

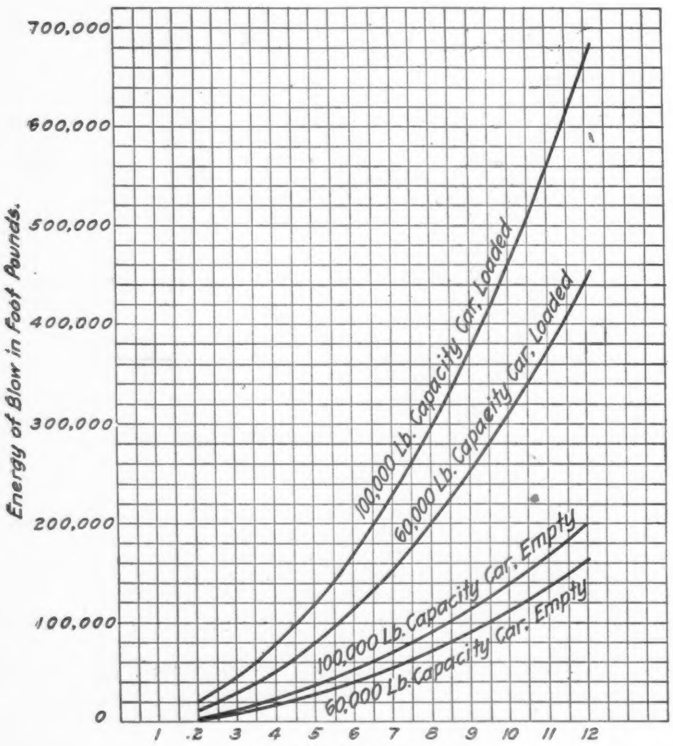


Fig. 2—Energy of Blow When Cars Strike an Immovable Body

draft rigging of a 60,000 to 100,000 lb. capacity freight car of all-steel construction under conditions met with in ordinary daily service.

TYPES OF DRAFT GEARS

There are on the market today two principal types of draft gears, and a third one which may be considered a combination of the two, namely:

(1) Spring gears, which, as the name implies, are springs which cushion the shocks.

(2) Friction gears which are dependent on the principle of the resistance to motion offered by two surfaces under pressure. The two surfaces are usually of like substances pressed together by stiff springs. Gears of this type, unlike the spring gear, tend to absorb the enerby of the blows delivered to them.

(3) Friction spring gears, or gears which absorb the blows delivered to them by the friction of their integral parts, which at the same time are distorted, producing the cushioning effect of the spring gear. Gears of this type are few and are generally considered as spring gears.

Of these three types the spring gear is the oldest, the second and third types being late developments, designed to meet the increased heavy demands of service. The action of these three types of gears will be best understood by an analysis of Fig. 3. In a static testing machine a friction gear gave the load curve which is shown. On applying the load, 105,000

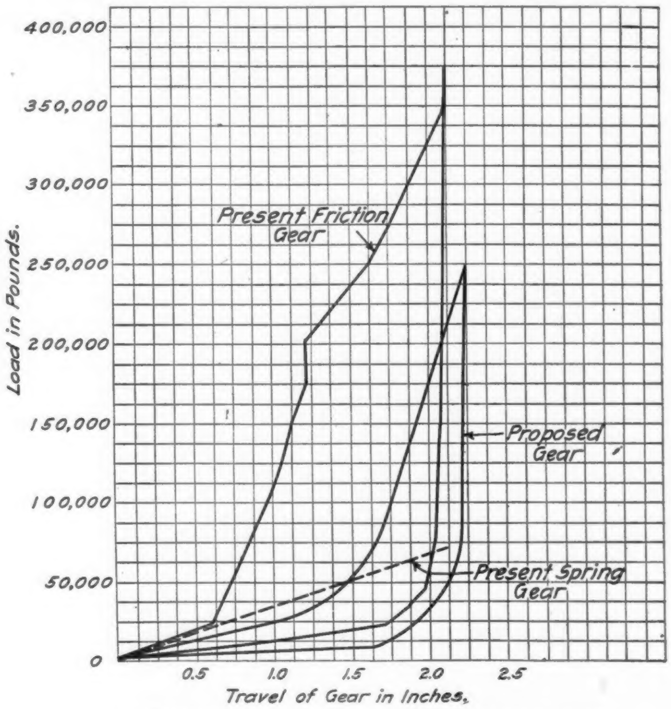


Fig. 3—Static Tests of Different Types of Draft Gears

lb. was required to compress the gear one inch, while the next half inch required an increase of practically 125,000 lb. On releasing, before the gear would move one-eighth of an inch, the load had to be reduced 325,000 lb. The spring gear, on the other hand, had an equal distortion for each increment of load and as the load was released the spring increased its length a corresponding amount. This in short represents the absorbing action, so to speak, of the friction gear and the cushioning action of the spring gear.

Another type of gear tested gave a diagram similar to that marked "proposed gear" and will be referred to later.

Certain tests made by a manufacturer of draft gears showed that his particular gear went solid under the blow of a 9,000 lb. hammer falling 28.4 in., which would be equivalent to a blow of 21,280 foot pounds. Two class "G" springs went solid under a 10 in. drop of a 9,000 lb. hammer, which is the equivalent of 7,500 foot pounds; the first gear had a travel of 3½ in. and the second gear a travel of 2⅛ in. The blow in the first case was delivered at a velocity of approximately 8.3 miles an hour while in the second case the blow was delivered at a velocity of practically 5 miles an hour. These represent the maximum of several tests which were accessible to the writer.

It will thus be seen that the present draft gears are probably driven solid quite frequently and that the car is called upon to bear the major part of many of the shocks, whether equipped with spring or friction gears.

DRAFT GEAR TESTS

In view of what has just been said in connection with tests of draft gears a brief statement concerning the present methods of testing them may not be out of place. There are several laboratory methods now used for testing draft gears, none of which may be considered as entirely satisfactory. This is due to the fact that the present tests do not represent actual conditions, and the results which are obtained are merely comparative for the various makes of gears under each particular set of tests.

The drop test, which is most used, while it measures the foot pounds of energy which will be required to make a friction or spring gear go solid, does not determine the ability of the gear to restore itself to its normal condition. The blows are delivered after the gear has restored itself to its normal condition, due to the load being entirely released. The time element in absorbing the blow is never touched upon.

The static load test, the results of which are illustrated in Fig. 3, does not apply nor release the load suddenly. Makers

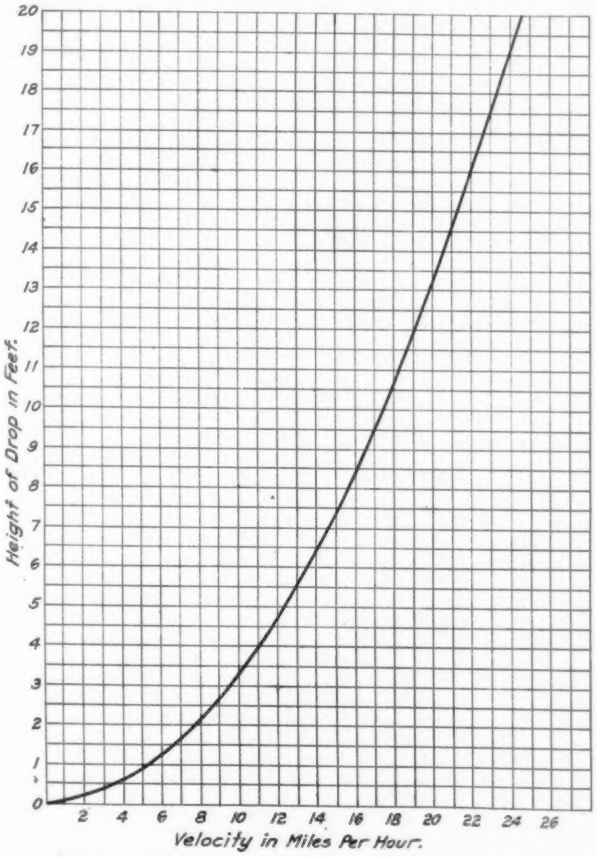


Fig. 4—Height of Drops to Give the Same Velocities as a Car Moving at Different Speeds

of the friction gears claim the diagrams mentioned represent the energy absorbing capacity of the gears giving such diagrams, but it is doubtful if this may be considered any criterion upon which to judge the fitness of a gear for service. The fact remains that gears which have made a wonderful showing during laboratory tests have fallen down in service within a comparatively short time.

The frequency and velocities at which the blows are delivered and the length of time that the gear is held in each particular position are the most important factors in the performance of a draft gear. There are no provisions in the present methods of testing for determining any of these factors, with the possible exception of the practice of placing a gear in a bulldozer and releasing and applying a load until failure of some part of the gear occurs.

The curve in Fig. 4 is given to show the height of the drop in feet required to deliver a blow at the same velocity as a car moving at a rate of from 1 to 24 miles an hour. It must be borne in mind when considering the results of drop tests that a small weight, comparatively speaking, falling a long distance, may deliver a blow of the same total kinetic energy as a heavier weight falling a smaller distance, yet the larger weight falling a short distance will produce a greater deflection of the gear tested than the light weight falling a longer distance, due to the fact that the rate at which the energy of the blow must be absorbed or cushioned is greater for the small weight falling the greater distance.

There is little doubt but that the best method of determining the relative merits of a draft gear is by means of an actual service test, covering a large number of each particular make of gear on cars of various types.

SERVICE RECORDS

The following tabulation is taken from a service record covering a total of 888 cars which were repaired during a period of thirty days in home shops. The percentages are based upon the total number of cars in service equipped with each type of gear.

DISTRIBUTION OF FAILURES COVERING 100,000, 80,000 AND 60,000 LB. CAPACITY CARS OF ALL-STEEL, STEEL UNDERFRAME, OR CONTINUOUS STEEL DRAFT SILL CONSTRUCTION

1.	Broken couplers	Friction	.193 per cent.
		Spring	.103 per cent.
2.	Couplers pulled out	Friction	.0033 per cent.
		Spring	.009 per cent.
3.	Followers broken	Friction	.018 per cent.
		Spring	.052 per cent.
4.	Draft gear parts bent or broken	Friction	.5 per cent.
		Spring	.098 per cent.
5.	Draft castings broken	Friction	.0184 per cent.
		Spring	.0087 per cent.
6.	Sheared draft casting rivets	Friction	.00 per cent.
		Spring	.0062 per cent.
7.	Sills bent or broken	Friction	.051 per cent.
		Spring	.042 per cent.
8.	Pocket rivets broken	Friction	.063 per cent.
		Spring	.366 per cent.

CONCLUSIONS

The above tabulation seems to indicate that with the exception of broken pocket rivets, broken followers and couplers pulled out, the spring gears on the cars of all-steel, steel underframe or continuous steel draft sill construction are giving better service than the friction gears on the cars of the same construction. Couplers having the coupler yoke keyed on would not only obviate the failure of pocket rivets, but would also facilitate the work of repairing broken coupler parts necessitating the removal of the coupler.

By the practice of replacing wooden underframes with underframes of steel and the application of continuous steel draft sills, several railroads have accomplished a great deal in the way of reducing failures due to the draft rigging. The draft rigging on cars equipped with friction gears is more difficult to inspect and repair than on cars equipped with spring gears and for this reason there are in service today cars whose draft gears are of no use so far as performing their duties properly is concerned.

The fact that broken couplers and draft gear parts are the chief causes of failure with friction gear, seems to indicate that it is the blows of 100,000 lb. and less that do the damage. These are usually delivered so quickly that the friction gear of 300,000 lb. capacity has not the ability to absorb them, while the spring gear with a capacity of 60,000 lb. has the ability to cushion such shocks before they are thrown fully upon the parts which are most likely to fail.

Considering the present draft gear equipment upon the market it would seem most practical to build cars of sufficient underframe strength to take directly the blows of 200,000 lb. and upward and to equip them with gears capable of absorbing or cushioning the numerous small shocks up to 60,000 lb. and 250,000 lb., above which limit the elasticity of the car body would be called into play. This would mean

that the spring gear of the class "G" type or a friction gear such as that proposed in Fig. 3 would be most serviceable.

With the use of friction gears of smaller capacity, but more initial elasticity, it is reasonable to suppose that methods of construction may be devised which will obviate the present objectionable features of construction and maintenance and insure better service from the gear.

BEST TYPE OF DRAFT GEAR FOR FREIGHT CARS

BY C. L. BUNDY
General Foreman, Delaware, Lackawanna & Western, Kingsland, N. J.

In your March issue you made the statement that one who has given the draft gear problem much study claims that inferior draft gears are costing the railroads of this country 250 million dollars a year in damage to equipment and congestion to traffic at terminals due to bad order cars. This seems high to me. However, it is a difficult problem and one has to take into consideration many other parts of the car that may fail, together with damage to lading and delays to traffic. We all know that inferior draft gears are responsible for many of the ills of the freight cars, and when we consider the great number of gears that have been designed, it shows conclusively that the trouble experienced has caused men to give much thought to the subject, hoping to bring out a design that would better meet the requirements.

With the increased weight and power of modern locomotives, double-head service, heavier trains, and heavier cars, the draft gear problem has forced itself more and more on our attention. Designs of gears that for some years gave entire satisfaction failed badly when heavier power and trains were introduced. The expense of maintenance of the draft gear has been on the increase and is a larger factor in the total cost of repairs to freight cars than it ever has been. In modern train service the shocks are beyond the capacity of any reasonable spring to absorb, and in case we had a draft spring with sufficient capacity to do this the recoil would cause many failures to couplers and other parts, and the damage resulting would make its use prohibitive. The draft gear must keep pace with the increased capacity of cars and heavier power and faster service. It has been demonstrated very thoroughly that the spring gear can not meet the present day service.

The draft gear on the freight car is the most important part of the car. There is little knowledge of the actual stresses to which the draft gears of freight cars are subjected to in actual service. In my opinion at least 70 per cent. of the damage to freight cars can be chargeable to buffing shocks, and it is these shocks that are causing most of the trouble. The prime requirement of an efficient draft gear is capacity for absorbing shocks, and at the same time it must be practically free from recoil. If we have a gear with sufficient capacity to withstand the shocks and relieve the underframe and superstructure, to a certain extent at least, of the many stresses they are subjected to, with sufficient flexibility between maximum and minimum because of its effect on the coupler, then we have an ideal gear and the best way to determine this is to test in actual service the different types of friction gears to determine to a certainty just what the gears will do.

I have come to the conclusion after a period of thirty years' continuous service building and repairing cars that there is a necessity for something better than the spring draft gear so commonly used. We should have a draft gear for freight cars capable of withstanding tensile stresses of 200,000 lb., and buffing shocks of 400,000 lb. Another most important thing to be considered is a means of taking up slack. Slack is bound to take place due to wear on the different parts and some means for taking up this lost motion must be provided, and in doing so the travel of the gear should not be reduced. The matter of slack in couplers or draft gears has never been given the attention it should, and cars are often allowed to run with from 2 to 6 in. of slack. This is bound to cause damage to other parts if it is allowed to continue.

The cost of maintenance of freight cars is on the increase and has been for a number of years. This is due to a number of reasons. First, inadequate draft gears; second, the rapid introduction of heavy power; third, frail construction; fourth, starting trains when it is necessary to take the slack a number of times. If all cars were equipped with a shock absorbing draft gear of sufficient capacity, much of the trouble and expense would be avoided.

The draft gear is receiving greater attention and a conclusive study would unquestionably cause us to recommend the application of friction draft gears to old cars that are considered worth repairing. Not until this is done can we expect the cost of maintenance of freight cars to drop. Figures as to the relative cost of maintenance of the spring compared to the friction gear show a vast difference in favor of the friction gear. Notwithstanding this fact many roads are slow in the adoption of the friction gear and as a result are the losers in the greater cost of repairs to the cars. This is true not only of draft gear parts but such other parts as longitudinal sills, end sills, draft timbers, doors, roofs, and car ends, to say nothing of damage to lading and delays to traffic.

Observation covering a number of years in the shop and yard repairing cars indicates that draft gear failures are more common than failures of any other part of the car. Any one doubting this statement can become convinced of the truth by visiting a few repair shops and noting the repairs being made. An adequate friction draft gear will reduce the broken parts of couplers and other parts of the car body and help in a large measure to keep bad order cars to a minimum.

J. C. Fritts, master car builder of the Delaware, Lackawanna & Western, in a paper before the Central Railroad Club at its September, 1913, meeting, gave some valuable data on draft gear, covering a period of twenty-six weeks, showing the failures of draft gears together with coupler and knuckle failures. This showed the friction gears to be far superior to the spring gears, the percentage of failures being 17 per cent, against 81 per cent. It proved conclusively the superiority of the friction gear over the spring gear, and if Mr. Fritts had included other parts, such as draft timbers, end sills, and longitudinal sills, which no doubt were broken in many cases, due to the spring gear, the result would show a still greater percentage in favor of the friction gear.

To determine to a certainty the relative values of the different classes of draft gear, and also to give manufacturers of spring gears a chance to test their gears against the friction gears, I would suggest that the railroads appoint a committee of five good practical men representing all the roads, this committee to be independent of the Master Car Builders' Association and to be instructed to fit up a number of cars with the different types of gears and test them out in service under all conditions, the cost of this test to be borne jointly by all the roads represented. A test of this kind would mean the survival of the fittest and would furnish valuable information for the railroads; at present many roads are applying draft gears, knowing little of the actual work they will perform. We have lost much time on this important subject and the matter should be taken up and settled definitely as soon as possible. After this test has been made and the merits of the different gears are known, any new gears designed should be submitted to be tested and not be considered unless they were as good as or better than the ones passed on by the committee. The device of any manufacturer who declines to submit his gear in this test should be treated as a gear failing to meet the requirements and classed with those the committee would not recommend. The expense of making a test of this kind would be money well spent and the amount would not be sufficient to work a hardship on any of the railroads.

My reason for recommending a special committee is that the

members of the present standing committee of the Master Car Builders' Association are busy men who can not spare the time to do this work to which the committee should devote its entire time until it is finished; in my opinion the service test is the only sure way to get at the facts as they exist. A test of this kind would result in many gears now in use being discarded and this would prove to be a saving not only in failures to draft gears, but the railroads would not be compelled to carry the different parts in stock.

I know from personal experience that most repair yard foremen make a practice of going over all the scrap material that is picked up along the line and brought into the shops and taking out all the serviceable parts of draft gears, knowing they will come in handy in making repairs to foreign cars; many times this saves holding a car for sixty or more days for material ord red from the company owning the car. The discarding of many of the different gears would render this practice unnecessary, at least to as great extent as at present.

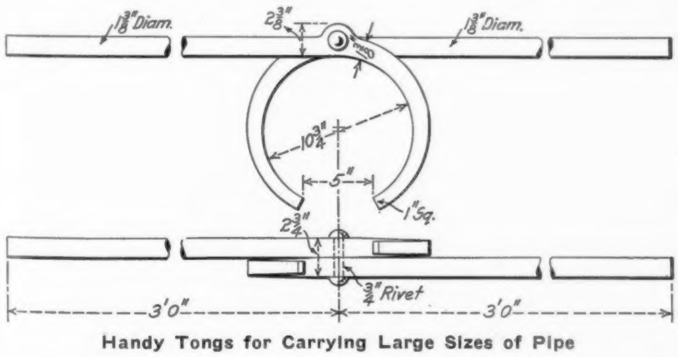
In considering the draft gear, I am afraid railroad officers are looking only at the first cost. If such is the case the small amount saved in first cost is soon spent in maintenance, to say nothing of the damage to other parts of the car and damage to lading and delays to traffic. The spring gear has failed to stand up and meet the present conditions. There are friction gears in use today that do stand the service, and if the railroads would adopt the friction gear I am satisfied much of the trouble with draft gear failures would be a thing of the past.

I have spent the greater part of my life in repairing cars, and have been in a position to judge as to which kind of gear gave the best results. In conclusion I would recommend the use of the friction draft gear for freight service and the testing in actual service of the different types of gears to determine the capacity for absorbing shocks, amount of recoil, and means of taking up slack.

TONGS FOR CARRYING LARGE PIPE

BY W. H. WOLFGANG

In handling large pipe where no crane is available the tongs shown in the drawing are very convenient. When placed around the pipe, from two to four men can lift on each pair of tongs,



Handy Tongs for Carrying Large Sizes of Pipe

thus handling the pipe without difficulty. The tongs are made of wrought iron or open hearth steel and may be made in sizes to fit any diameter of pipe.

Railway Ties in New York State.—In New York's railways of over 8,000 miles practically all of the ties used in the tracks come from other states. Longleaf pine and oak are brought from the South and chestnut from the southern Appalachian mountains. These ties now cost the railroads from 65 to 80 cents apiece, whereas 15 years ago they could be purchased for from 35 to 50 cents apiece. Many railroads are planting trees to supply ties for the future.

STUDY OF AN INTERNAL TRANSVERSE FISSURE IN A FAILED AXLE*

BY ROBERT JOB

In view of the importance and the dangerous character of the type of failure known as "internal transverse fissure," we have taken especial interest in the study of a 10-in. driving axle which recently came under our observation. The axle in question was of plain carbon steel, annealed, and said to have had no subsequent heat treatment. It was received in a shipment direct from the manufacturers and upon receipt at the shops, while a cut was being removed in a lathe prior to mounting, it broke in two about 20 in. from the end. The appearance of the fracture is shown in Fig. 1. A band of bright, clean, unoxidized metal is seen around the circumference and extending about 1 in. toward the center. Inside of this band the surface of the metal was discolored and oxidized. This condition did not extend into the steel longitudinally, but was simply an oxidized transverse fissure which extended over the inner portion of the fractured area. The surface of the transverse crack was rough and irregular, and two longitudinal fissures were

Fig. 1—Fractured Surface, Showing Oxidized Internal Transverse Fissure with Bright Metal Around the Outside

found, one across the center of the axle and the other about 1½ in. from the circumference.

Three borings, from the inside and from the outside portions respectively, were taken for analysis. The analyses are as follows:

	Outside	Inside
Carbon, per cent	0.48	0.47
Phosphorus, per cent	0.022	0.019
Manganese, per cent	0.46	0.46
Sulphur, per cent	0.036	0.031
Silicon, per cent	0.142	0.161

The chemical composition, outside and inside, is closely alike and within the usual limits. It does not indicate the cause of failure, and the fact that the proportion of silicon is moderate indicates that no excessive amount of slag was present, although slag inclusions were found.

Test specimens were cut longitudinally from the axle, one from the bright outside portion close to the surface, and one from the oxidized portion about half way between center and circumference. The results of the tension tests are as follows:

	Outside	Inside
Tensile strength, lb. per sq. in	92,340	76.030
Elastic limit, lb. per sq. in	54,080	45,410
Elongation in 2 in., per cent	14.5	5.5
Reduction of area, per cent	29.6	12.3

In the outside portion it will be noted that the elongation and

*Abstract of a paper presented before the American Society for Testing Materials, at the seventeenth annual meeting, June 30 to July 3, 1914.

the reduction of area of the metal are below normal, while in the inside portion the results indicate radically defective material.

Microscopic examination was made from sections cut from the above test specimens with results shown in Figs. 2 and 3, at 50 diameters. From these photomicrographs it will be noted that the size of grain in the outside portion of the axle was coarser than that in the inside portion, and that the size in the inside portion was fairly fine, indicating a proper annealing temperature at that point. A slag inclusion is shown in each of the photomicrographs.

We next cut a transverse section from the axle close to the point of fracture and on polishing and etching with iodine we obtained the result shown in Fig. 4. In this we found that one side of the axle—the upper part in the figure—was coarse-grained, while the center and lower part were of fine-grained structure with gradual coarsening near the surface. The steel throughout the section was rather porous and contained occasional small cavities and slag inclusions. Fig. 5 represents the condition at one of these locations, at 50 diameters.

The relatively coarser grain upon the outside surface around the entire circumference than inside proves that by the time the refining temperature had penetrated to the center of the axle, the steel upon the outside portion had been overheated, causing increased granular size, and resulting in a lower elongation and reduction of area than would have occurred otherwise. This condition simply means that the annealing temperature was not properly controlled; in other words, it is evidence of lack of careful mill practice.

The fact that the size of grain is decidedly larger upon one side of the axle than upon the other proves that the temperature upon the one side was decidedly higher than that upon the other. This condition could be produced by use of an unevenly heated annealing furnace, or it would also result provided the axles in the charge after annealing had been cooled unequally in any manner, as, for example, by opening the door of the furnace in the winter, and exposing the adjacent steel to the cold air. The same condition could also occur if a charge of axles was removed from the annealing furnace when at a red heat, and allowed to remain piled together with the outside portion exposed to cold. The effect would be to chill the side of an axle exposed to water or to cold air, while the other side in contact with other red-hot axles might easily be maintained for a considerable time at a temperature above the critical point of the steel. Under these conditions, owing to the difference in relative rates of contraction, severe torsional strains would be induced which might easily cause rupture of the metal.

The fact that the steel was porous in spots and contained slag inclusions is an indication of insufficient cropping to get to sound metal—in other words, defective mill practice—and such condition would naturally result in weakness which would lessen the force necessary to produce fissures. The relative weakness and brittleness of the interior portion as shown by the tensile properties is fully accounted for by the evident lack of proper cropping at the mill and the intense strains to which the metal had been subjected.

DISCUSSION

It was maintained in the discussion that this particular fracture did not resemble the transverse fissures that are so common an occurrence in steel rails. It was not thought that this fracture could have occurred because of defective rolling or short cropping, but that it could have been caused by improper heating of the ingot before rolling. If the cold ingot were to have been placed in a hot furnace and the outside rapidly heated, it might have so expanded on the outside as to have put sufficient tensile stress on the interior to cause it to fracture and show a lense-shaped cavity like that described.

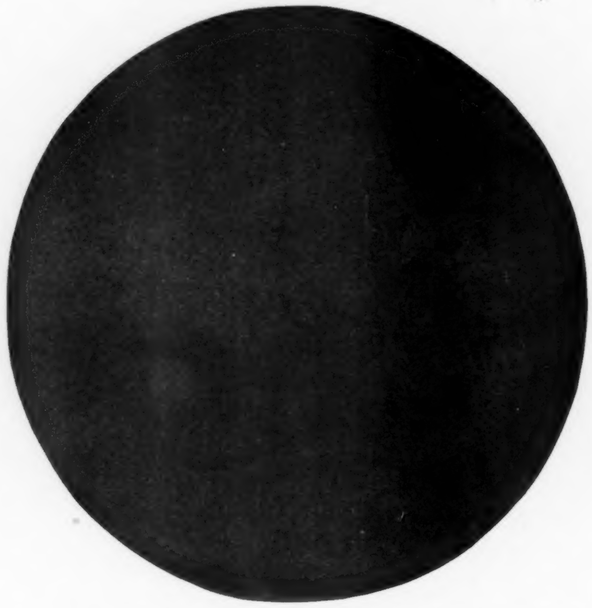


Fig. 4—Transverse Section, 1 In. from the Fracture, Polished and Etched with Iodine

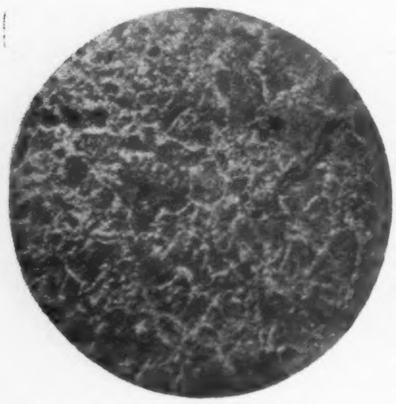


Fig. 2—Bright Outside Portion, About ½ In. from the Surface, Polished and Etched with Iodine; 50 Diameters

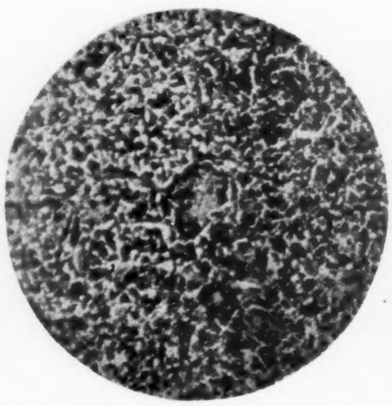


Fig. 3—Inside Oxidized Portion, Midway Between Center and Circumference, Polished and Etched with Iodine; 50 Diameters

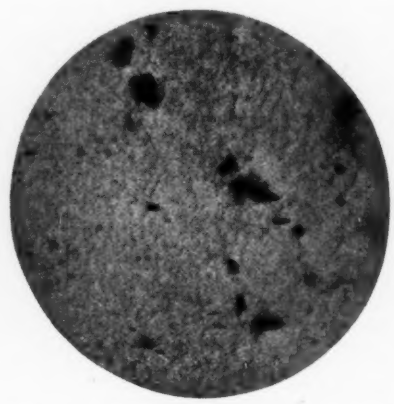


Fig. 5—Porous Steel. Section Near the Fracture; 50 Diameters

New Electric Railway in Russia.—Plans have practically been completed for the construction of an electric railway from Riga to Assern, a summer resort on the Gulf of Riga. The new line will be about 19 miles in length.

General Foremen's Convention

Including Papers on Engine House Efficiency, Air Brake Maintenance and Other Shop Problems

The tenth annual convention of the International Railway General Foremen's Association was held at the Hotel Sherman, Chicago, Ill., July 14-17 inclusive, W. W. Scott, general foreman of the Delaware, Lackawanna & Western at Buffalo, presiding. The opening prayer was offered by Rev. Peter J. O'Callaghan, and the association was welcomed to the city by Leon Hornstein on behalf of the mayor of Chicago. W. T. Gale of the Chicago & North Western responded to Mr. Hornstein's address. F. A. Delano, president of the Chicago, Indianapolis & Louisville, addressed the association at the opening session, taking as his subject "Scientific Management." Briefly, Mr. Delano mentioned the purpose and the meaning of scientific management, and pointed out that in the main it was a new application of old ideas. Whatever kind of management is to be followed it is necessary to have co-operation, which, in turn, is dependent on leadership, and that, in turn, requires organization. Mr. Delano made it plain that in order for a foreman to succeed he must carefully consider these three items.

President Scott's Address

Recent events have brought rather prominently to public view the question of efficiency and economy in railroad operation. As railroad officers, efficiency and economy has been our constant watchword. Publicity has not until recent years entered very largely into railroad operation and the public has often been led astray by not being correctly informed as to the methods of efficiency and economy practiced by the railways. Every published statement reflecting credit on the railways, whether relating to their good intentions or to their able management, strengthens them in the public esteem and tends to promote a wise and judicious solution of the problems of government regulation. There are none of us who wish to evade discussion of our efficiency. As far as the mechanical department is concerned, our efforts have not been sufficiently brought to the light of public recognition. This is one of the purposes of our association. Here the standard of efficiency and economy in the performance of every function incident to the manufacture and maintenance of the locomotive has been advanced by comparisons of experience. It is here we have our suggestions to offer for the betterment of our power. It is here that our companies reap the benefit of our experience, thought and labor. To that end, therefore, we should all participate in the discussion as freely as possible.

It is recommended that the subjects presented at this convention for discussion be retained for next year, except the two subsidiary papers, and also that the number of members on the committees be increased to ten and that they be selected from roads in different parts of the country in order that all the conditions due to climatic or other unusual conditions may be considered. On account of the close relationship between the general foremen and the Tool Foremen's Association, it is believed that if it is possible it would be much to the advantage of both associations to have them meet during the same week.

Engine House Efficiency

BY W W. SMITH
Chicago & North Western, Chicago, Ill.

In the report on engine house efficiency presented last year, the different phases of the subject were treated in a general way. The subject was continued so that new material could be added.

Engine Mileage.—The operating department by co-operating with the mechanical department can do much to increase engine mileage. Trains are oftentimes too long on the road due to poor train despatching or overloaded engines; engines are delayed to and from the train yards and the engine house; engines are delayed by yard forces not having trains made up; and oftentimes trains come in or are ordered out in bunches, so that the engine house organization cannot handle the engines in the manner they could if the trains had been properly spaced. In storing engines, those should be kept in service whose mileage comes nearest entitling them to a shopping. If poorer engines are stored, the good ones are being worn out during the dull season. There is undoubted economy in long runs for passenger engines, even though they are more conducive to engine failures. In order to make long runs a success, locomotives must receive very careful attention at engine houses.

Pooled or Assigned Power.—Whether it is best to pool power, or assign each engine to a regular crew, is a problem important to engine house efficiency. When an engine is assigned to a regular crew, it is given more attention by the crew, there is less apt to be delay in getting away from the engine house, failures are less apt to occur, and the cost of maintenance is sure to be less. A system of regular assigned engines has been inaugurated on some of the divisions of the Chicago & North Western, with very gratifying results. The runs are pooled—that is, regular engines are not assigned to certain runs, but an engine crew with a regular engine will take any run that their turn on the board entitles them to.

Terminal Delay.—The greater cost and earning power of recent locomotives makes it more necessary than ever to keep them in service. The question of turning engines promptly is one of system and supervision. In turning engines at terminals, the most valuable units of power should be given the preference. Also the ash-pit tracks should be arranged so that engines not requiring washing out, or other heavy work, can be run around those requiring washing out. Where a hot water fill-up line is provided, a considerable saving in time can be made by letting water out of the boiler and re-filling with fill-up water which is nearly at a boiling temperature. The engine house foreman should always be in a position to quickly and accurately advise the transportation department when he expects engines to be ready for service. Then a definite prospective figure should be given to the yardmaster two hours before the engine will be ready, from which figure the engine should be ordered.

Engine Delays.—At busy terminals, where important trains are despatched, whenever possible, an extra freight and an extra passenger engine should be fired and ready for service, so that in case of the unexpected happening, there will be an engine to fall back on. A running log book will tend to eliminate delays from the failure of either the day or night engine house foreman to notify the other concerning repairs that are left unfinished. It should be the duty of the turntable operator or his assistants to keep posted on the time that engines are ordered, and see that engines get out on time.

Engine Failures.—Each new failure should be carefully studied, as well as the past failures shown on the records. In this way it is possible to arrive at conclusions, and thus take action to prevent recurrences. Oftentimes some simple little contrivance will prevent costly failures. Enginemen should be required to report any unusual trouble or delays they have encountered on the road due to the engine or cars—even though a failure has not been charged by the transportation department. When there is any doubt as to the successful outcome of a trip, the road foreman should be called to ride the engine.

Mileage Between Shoppings.—It is probably best to compute

locomotive costs on a ton mile basis so there will be a tendency on the part of master mechanics and others to keep engines in 100 per cent. efficiency as long as possible, and then when it proves impracticable for the engine house to further maintain them at their full hauling capacity the engines should be shopped. As an average figure for all roads, freight locomotives do not make more than 40,000 miles between shoppings, and passenger engines not more than 80,000-100,000 miles. Ordinarily it is considered good practice to expend 60 per cent. of the maintenance costs in the engine house, to insure best road service, and 40 per cent in the shop.

Too frequently the shop and engine house do not work in harmony. There are many things, while an engine is stripped down in the back shop, that can be done for about one-third the expense they could be done for, four or five months afterwards.

Economy in the Engine House.—The intelligent ordering and use of material, careful watch on store house supplies, close attention to fuel consumption, etc., are factors that must be watched. There are unlimited possibilities for saving fuel at the engine house. Cylinder and valves blowing, cylinder cocks and relief valves that do not seat, leaky whistle and pop valves, leaky boilers, steam leaks in the cab, improperly drafted front ends, bushed nozzles, etc., are all sources of waste that are caused by imperfect maintenance. Then there are direct losses of fuel at engine house, due to tanks being overloaded, to uneconomical methods of firing up engines, to engines popping off on cinder pit track while waiting to have fire cleaned, to engines fired too long before they are ordered, etc.

Each engineman should have an individual tool box, which, together with the oil cans, should be removed from the engine at the end of the trip by the supplyman. Engine cushions should be securely fastened to the seats, and suitable boxes or racks should be provided in the cab, for lanterns, emergency signals, etc. In order that each fireman may have his own shovel, a suitable rack should be placed in the engine house to which shovels may be chained and locked.

Handling of Switch Engines.—When switch engines are delayed at the engine house, or are so poorly maintained that they cannot do effective work, the train service is correspondingly impaired. The engine house should make every effort to furnish switching power on time. As an aid in doing this, the work at the cinder pit should be very closely supervised at noon and at midnight, when a number of engines are in at the same time to have fires cleaned. Switch engines should be held in for inspection and repairs at stated intervals. On several roads, at important terminals, a system of relief engines has been adopted. With this plan a relief crew is engaged in taking engines to and from the engine house and yard, and the regular yard engine crews do not come to engine house with engines.

Organization.—The subject was considered in some detail in last year's report. In most engine houses it is advisable to have at least one engine held in for repairs so that the amount of work can be balanced. Thus when running repairs are heavy the men can be borrowed from the laid-in work, and when running repairs are light they can be shifted to the heavy work. As far as possible vacancies should be filled from men in the ranks, and the vacancies in the day force should be filled from men in the night gang. When workmen know that good service will be rewarded by promotion, it is an incentive for them to do good work and stay in the service.

Co-operation.—The fundamental principle involved in getting good engine house service is the individual interest of every employee concerned, and the co-operation of all. Probably no other one thing can do quite as much to reduce the net earnings as friction or ill will between the operating and mechanical departments. The closer officials of the two departments get together, the better will be the results. The master mechanic or foreman should call up the train despatcher the first thing in the morning, and help him to line up things, thereby heading off probable failures, and in return receiving valuable information for his department.

A friendly spirit of co-operation should exist between master mechanics and foremen of different divisions. It often happens that engines from one division run into the terminal of another division, and unless there is harmony between the men of the two divisions the best interests of the company must be sacrificed.

Terminal Facilities.—The basis of efficiency of a locomotive terminal is time, and everything should be arranged with this idea in view. To obtain the best results in saving time between the yard and the turntable, the engine house should be as near as possible to the yards, and connected up with suitable tracks so that the necessary running back and forth can be done independent of the main line; also there should be separate tracks used for incoming and outgoing engines. The cinder pit is the critical point in the locomotive terminal, and this is especially true during severe winter weather. It should be located as close as possible to the turntable, and large enough so that a sufficient number of engines can be handled at the same time.

The engine house should be long enough so that all engines can be housed, and with some room front and back and at the sides so that the work will be facilitated as much as possible. It often becomes necessary to move engines in order to make repairs to rods, etc., and if the rails are extended beyond the front end of pits, the engine can be moved ahead instead of back; thus making it unnecessary to have doors open in winter time. Pit drainage is also a very important factor. Good natural lighting is one of the most important features leading to a high efficiency in engine house work.

A hot water washing and filling system is almost a necessity in any important engine house. Not only is there a considerable saving in the time that engines are held out of service for boiler washing with this system, but there is the added advantage of increasing the life and improving the condition of the boilers themselves. A blowing down line should be included in the system, and it should have a capacity sufficient to empty a boiler with 180 lb. pressure in not more than 30 minutes. Washout water should be provided for washing out with a pressure of at least 100 lb., and at a temperature of about 150 deg. Then the filling up line should furnish water at a temperature of about 190 deg.

The drop pit section of the house should be from 100 to 112 ft. long, so that engines can be spotted in any position with the doors closed. In engine houses where it is the custom to make fairly heavy repairs, a drop pit should be provided for dropping the entire engine truck in the pit, so that repairs can be made to male casting, cylinder frame bolts, etc.

There should be a vise bench at every other stall. Some consider the location against the outside wall as preferable to between the stalls on the posts, the reason being that in the former position more room is available to work on engines.

Inspection pits placed on the incoming tracks should be shallow and simply deep enough to enable a man to examine all parts underneath. These pits certainly facilitate the movement of engines in busy times. It often happens that an engine on reaching this pit will be found on inspection to have but a few nuts loose here and there or is in need of some slight repairs that can be made on the pit. The engine then passes through its different operations, goes on the table to be turned and is ready for a return trip. This saves putting the engine in the house at all.

Locomotive Maintenance.—Locomotive maintenance costs continue to rise, but when we make allowance for the increase in wages, the increased cost of material, and the added complexity of the modern locomotive, the cost of repairs per unit of work has been actually decreased. All important engine houses should be furnished with an ample supply of spare parts, such as air

pumps, lubricators, injectors, bell ringers, etc., which should be used to replace defective apparatus, whenever it will take less time to exchange than to repair.

Running Repairs.—The heavy labor cost that attends the removal of driving wheels in the ordinary engine house requires that most of the running repairs to locomotives must be made without removing the drivers. Driving boxes cannot always be taken care of in the engine house, but the careful maintenance of the wedges will do much to keep the driving box brasses and the rods in good shape. In order that driving box brasses may be maintained in the engine house, and without the necessity of dropping drivers, driving boxes with removable brasses have been adopted as standard by the Chicago & North Western. In order to lighten the maintenance costs of shoes and wedges several roads have adopted a flangeless shoe and wedge; also a new design of driving box which has part of the inside back flange removed, so that wedges can be lined down without taking down the pedestal binder.

Lateral motion in drivers, trailer and engine truck wheels is one of the hardest problems to contend with in the maintenance of locomotives. In order that end play may be taken up in the engine house without dropping the wheels, and without holding engines from their runs a box has recently been introduced with removable lateral motion plates with babbitted faces. These removable plates can be used on engine and trailer truck boxes, as well as on driving boxes. They have been adopted as standard on several roads. As an aid in taking up lateral in engine trucks, it is the custom on some roads to babbitt both sides of engine truck boxes when engines are undergoing repairs, so that in the engine house it is only necessary to turn the boxes end for end to take up the lateral.

With the marked increase of weight and power of locomotives, the tire mileage has decreased, but by use of improved heat treated and vanadium steel tires, the mileage has been increased in some cases. Vanadium steel tires should be expected to give nearly twice greater mileage than the ordinary carbon steel tires. Tread wear can be lessened to some extent by keeping sanders in good order, and seeing that the steam distribution is equal, so there will be no unnecessary slipping of drivers. Tires are sometimes flattened by a poorly maintained driver brake. In order to prolong the life of tires, they should be changed or turned before the flange wear is excessive; otherwise an undue amount of stock must be turned from the tread to get a full flange. For the same reason steel or steel tired engine truck or tank wheels should be changed before the flanges become sharp. The retaining rings reduce the liability of failure from loose tires, but they make it very inconvenient to change or shim tires, and hence increase the cost of maintenance. From an operating standpoint a lip on the tire is almost as good as a retaining ring.

When driving boxes and wedges are well maintained very little trouble is experienced with rods. In order to lighten the maintenance of main rods, two designs of solid end main rods have been recently introduced. With both types straps and bolts are eliminated—only wedges and filling blocks being used in connection with the brass. The Foulder design uses the same pattern of brass both at front and back of the pin, while in the Markel rod the brass is cast in steel blocks. The former has to be removed from the pin when it is dismantled, but the latter can be dismantled on the pin.

Sand plays a very important part in the performance of locomotives, both from the standpoint of fuel economy and of handling tonnage, so that it is imperative that engines leave terminals with sanders in good working condition. The quality, the drying and cleaning of the sand, must be given careful attention. The secret of getting good service from sanders is the careful attention given to the piping. Fifty per cent of the sand failures are due to split and loose pipes not pointing to the rail.

With the engines now in use, injectors are often required to supply as much as 150 gal. of water per minute, when engines are operating at full capacity. Hence the need of maintaining tank valves and siphons, feed and delivery pipes, injectors and boiler checks, in good condition. In order that coal which accidentally falls down the tank manhole, cannot work ahead to the tank valves or siphons, it is the practice on several roads to extend a splash plate across the tank in front of the manhole, and cover the opening at the bottom with screening.

All piping should be securely stayed and clamped, otherwise it is impossible to prevent leakage and breakage. A new system of clamping has recently been developed, whereby the pipes are held rigidly in place by suitably located castings, which are in most cases attached to the boiler. The method and arrangement of piping is very important, and to obtain best results ball jointed pipe unions should be used, and they should be located in a place accessible for tightening; also elbows should not be used when it is possible to bend the pipe. Copper pipes sometimes give trouble by wearing through where they come in contact with the sharp corners of metal cabs and running boards. In order to prevent trouble from this source, it is the custom on several roads to enclose the copper pipe at the exposed places with iron pipe of larger size.

It is the practice on some roads to give cabs a thorough examination every three months. And if they are found loose or in an unsafe condition proper repairs are made at once.

Boiler Maintenance.—The systematic use of blow off cocks in connection with soda ash treatment results in greater life of the flues, longer periods between washouts, decreased scale formation, and fuel economy. The following rules should be observed in the care of boilers at terminals:

When fires are being cleaned or dumped, the blower should be used only sufficiently strong to prevent smoke from emitting from the firebox door.

The fires of all engines awaiting service should be banked at the front flue sheet.

Unless absolutely necessary, injectors should not be used while fires are being cleaned, or when there is no fire in the firebox, nor while locomotives are being used on their own steam, without first brightening up the fire.

It is the consensus of opinion that boilers should be washed with hot water. When hot water is used the boilers should be filled through the blow off cocks located in the water legs; when cold water is used they should be filled through the injectors. In order to facilitate the work of washing large engines, suitable stands should be provided for the boiler washers, and portable troughs should be used to direct the stream of water from the mud ring into the pit. A sheet of canvas should be thrown over the part of the locomotive that will in any way become defective on account of the water from the boiler when washing. A sheet of canvas should also be placed over the engine truck, so that the cinders from the front end will not fall into the engine truck boxes.

The brick arch, like other boiler appliances, must be properly maintained in order to give effective service. It should not be disturbed except when absolutely necessary; when it is necessary to bore or work on the flues, only the center row of bricks should be removed. Only enough bricks should be taken out to enable the operator to get at the tubes, and they should be removed as carefully as possible to avoid breakage. To get best results special men should be assigned to the work of keeping up arches.

Locomotive Inspection.—Where the most satisfactory results are attained, inspection is made by a force of special inspectors who have been trained to inspect certain parts of the engine. This practice is followed at some of the important division points on the Pennsylvania Railroad. The head inspector examines the outside of the engine and tender, and looks at the trucks, wheels, draw gear, brake rigging, couplers, grab irons, footboards, pilot steps, and all safety appliances. He gages the couplers for height, wear of knuckles and heads, examines the knuckle-lock pins, etc. He examines driving wheels, flanges and

tires, main and side rods, brasses, knuckle pins, crosshead pins, crossheads and guides. He looks for loose pipes and clamps, oil cups and lids, cracks or breaks in the frame, working of the cylinders, missing or defective safety pins, and examines the valve gear, springs and spring rigging. He reports hot bearings, leaky washout plates or plugs, or any other defect that may come under his notice. He has charge of the other inspectors, and sees that each inspector makes out a report for each engine inspected. Another engine inspector starts in under the pilot and examines all parts under the engine and tender.

The head air brake inspector examines the brake valve, air pump, gages and governors, noting the dates on the tags. He reports them for attention after 30 days from the date on the tag. He examines air pipes and reservoirs, the sanding devices, gage glass and gage cocks. He is required to try them and blow them out. He notes the condition of the fire door, the apron and foot plate, washout plugs, sprinkling hose, etc. He examines the throttle gland to see if the packing will last until the engine is due for washing. His most important duty is to examine the crown and side sheets for leaks, and to note the condition of the flues. This examination is made in the presence of the engineer, and before he goes off duty. This inspector also examines the stay-bolt and boiler washout tags, notes when the engine is due for staybolt test or boiler washing, and keeps a book record of these items.

One duty of the head air brake inspector on roads equipped with track troughs is to lower the water scoop while the man underneath gages it, to see that it is neither too high nor too low. This man underneath is also an air brake inspector, and he examines all air pipes, hose and connections below the running board, brake rigging of engine and tender, notes the piston travel and locates leaks of every description.

The steam heat inspector examines all valves in the cab and at the rear of tender, all joints and pipes between engine and tender, and on front and rear. He tests the governor to operate at 100 lb., and reports any leaks or defects in the portion of the equipment for which he is responsible.

When these examinations have been completed, from four to five minutes being sufficient, each man writes his report on the proper form, and sends it by pneumatic despatch tube to the engine house office. By this means the reports covering the condition of the engine reach the work distributor's desk almost as soon as the engine reaches the ash pit.

DISCUSSION

The convention seemed generally in favor of assigning power, and several cases were mentioned where roads had gone back to the assigned power from a general pooling system. It was pointed out that the enginemen would be more interested in the condition of their locomotives, report defects that they otherwise would not bother about, and follow up the defects to see that they were properly corrected. As a general proposition, by assigning power the mileage between shoppings will be increased, the engines will be maintained in better condition, there will be a decrease in the cost of locomotive supplies, a decrease in locomotive failures, and a decrease in the necessary shop force to maintain the locomotives. It is also possible to locate the man that is not giving his engine proper attention. In the pool system one careless man will often cause defects on most of the engines he handles. N. B. Whitsel, of the Chicago & Western Indiana, which road handles the engines of several tenant lines, reported that a marked difference could be seen on engines used in the pooling system and those that were assigned to special engineers.

J. S. Sheafe, master mechanic, Baltimore & Ohio, pointed out that much could be done by the general foreman to decrease the time the engines are held at the terminal, mentioning that on one road it had been found that it took 19 hours to get a locomotive from the ash pit ready for service. In this connection, the inspection pit was spoken of as being of great advantage. The Central of Georgia cover their inspection pits and find that the men will take more care in going over an engine, especially in rainy and hot weather. One member stated that 90 per cent of the engine failures could be charged to poor inspection and organization. The lack of organization has a great deal to do with the terminal delay.

In regard to the mileage between shoppings, some members took exception to comparisons that are frequently made, as in some cases, locomotives are much more heavily loaded than in others and again some roads have a different system of making repairs in the roundhouse and back shop which materially lengthens the time between general shoppings. Exception was taken to the author's cost of $2,000 for general overhauling; it was believed that when the best grade of work is done and satisfactory material is used this cost will run up to $2,500, or even to $6,000, according to the size of the power.

Regarding economy in the engine house, it was pointed out that much could be done by keeping small material, such as shims, etc., in the storehouse ready for use. At the Burnside shops of the Illinois Central a meeting is held once a month of all the foremen in the plant, and economies around the plant are discussed and suggestions offered by the various foremen. The men are made to appreciate the cost of various articles and in this way are more particular as to the material they are liable to waste. A close supervision is kept on material and especially on scrap. In this regard, it is policy to specialize the work as much as possible, have certain men do piston work and certain men the rod work, etc. Several roads are cleaning their engines with oil and hot water, and find that it gives very good results.

The members seemed to be thoroughly in accord with the writer of the paper as regards the co-operation between general foremen, roundhouse foremen and the chief despatchers. Many times a foreman can so advise train despatchers in case of engine failures out on the road that much time can be saved and many times their advice will prevent a failure.

THE GENERAL FOREMAN AND SHOP EFFICIENCY

J. S. Sheafe, master mechanic of the Baltimore & Ohio, spoke on the relationship of the general foreman to shop efficiency. He pointed out that the general foreman must have a good organization. The sub-foremen should be capable of carrying the detail load in their respective departments, but at the same time, the general foreman should keep in touch with the work in a general way. A general foreman should use tact in dealing with his sub-foremen and treat them with the same respect that he would like to be treated by his superiors. Driving or rough treatment of the men has only a temporary effect. Efficiency does not always mean increased production, but includes the economical use of locomotive materials; do not scrap material too hastily.

A. Masters, of the Delaware & Hudson, in replying to Mr. Sheafe, mentioned that the capacity and ability of a general foreman are measured by the subordinates he has under him, and that he should so treat them that they will reflect to his credit. The opportunities for the general foremen are very good, as they are generally on the road to advancement and should train themselves accordingly.

ADDRESS BY A. P. PRENDERGAST

A. P. Prendergast, superintendent of machinery of the Texas & Pacific, gave an address from which the following is taken:

It is my conclusion, after nineteen years of practical contact with shop employees and conditions, that our men are largely what we, as foremen and supervisors, make them. The success of any organization or body of employees is dependent upon the manner in which they are directed and developed. It is difficult to establish and follow a defined system by which alone to govern the supervision of the various departments of our shops, and especially repair shops. It is, therefore, necessary to give study and consideration to each individual employee in order to under-

stand his fitness, and to bring out the best efforts of our men without resorting to undesirable methods.

Failure on the part of foremen and supervising officers of higher rank, to give sufficient thought to the adaptability of employees for the different lines of work, as well as a lack of interest in rendering assistance to employees as they undertake duties that may be new and difficult to them, is largely responsible for the aggressive attitude of many of the employees and the tactics to which they sometimes resort. The failure to show opportune acts of kindness and thoughtful consideration to our employees has resulted in lack of interest, which in some respects borders on disloyalty; employees who have been allowed to drift are usually influenced by other sources that do not contribute toward their improvement.

Lack of attention to details by foremen is a contributory cause of mental disturbance in employees, which in turn interferes with their capacity for production. I refer particularly to the failure of foremen to interest themselves in the matter of conveniences for employees in the handling of their work, as well as providing for their bodily comfort. It is a common condition in many shops to find employees trying to make headway with defective tools. Difficulty is also experienced because of delays to which they are subjected in securing their work from different departments; frequently this is the result of a privileged foreman being permitted by those in charge to demoralize the organization. The general foreman is one of the most important members of the organization in repair and manufacturing shops; the success of any shop management is largely dependent upon him. It is, therefore, essential that he set an example that will serve as a strong incentive and guide to the employees in his charge, both on and off duty. I have always found a large percentage of railway employees prone to follow their leaders. The necessity for shop supervisors to conduct themselves along lines that are above reproach is just as important to their success as it is for them to give their willing and continuous application to the duties and responsibilities entrusted to their care.

One of the most common causes I have found to be responsible for ineffective operation is the disposition to delay important duties until a more opportune time, which never arrives. How many times have foremen been heard to repeat some old complaint about conditions, the relations to some other department, etc., until it almost appears that this old trouble upon which he harps completely monopolizes his attention and energy, while still going along unimproved. At the same time many matters from which he could get some results, are going completely by the board.

Foremen should never lose sight of the obligations they are under in developing employees from the ranks to fit them for advancement. The officer in charge of men, who fails to educate and interest himself in the advancement of those under him, can be numbered with the indifferent leaders who have done much to promote antagonism and disloyalty in employees. I cannot urge too strongly upon all foremen, and all others engaged in a leading capacity, the great value derived from the study of the personality and capacity of the individual men under their jurisdiction in order that as necessity or opportunity presents itself, they may be in a position to put the right man in the right place. Beware of the "Indispensable" individual. An organization which rests upon such a one is, to say the least, unstable; the efficient manager, long before necessity for any changes develops, will have located the man qualified for advancement.

To properly start a foundation for the organization of shop employees we should begin with new employees entering the service, by directing their training along the lines that will develop their individual talents and create the appreciation that loyal employees have for their work and for leaders who take the proper interest in their progress. The instruction and development of apprentices on the part of those in charge is essential to the success of all departments. Co-operation is essential between departments; we must sacrifice the tendency to build a fence around our own particular work. We have but one object, after all, which is to produce safe and economical transportation.

VALVES, CYLINDERS, CROSSHEADS AND GUIDES

BY J. T. MULLIN
General Foreman, Lake Erie & Western, Lima, Ohio

Piston valves on superheated locomotives should be examined once every thirty days, as we find a great amount of carbonization of the oil occurs from high temperature. We find that in order to gain the speed power, and the saving of coal and water, piston valves with the Stephenson valve gear should be set in the negative lead for superheated locomotives. Slide valves are set at different positions; we find that for passenger service ¼-in. at 25 per cent. cut off, freight service ⅜-in. at 50 per cent. cut off makes a very economical setting.

When locomotives are shopped the valves should be examined and put in first class condition. The slide valve seat should be faced and slightly spotted. Valve strips should be fitted in the valve grooves and the strips spotted to the friction plates. The spring should be properly adjusted so that grooves will not be worn in the friction plates. Piston valve and valve chambers when worn 1/32 in. should be bored, and new valve rings should be perfect fitted to the valve chamber and should be 3/32 in. larger than the valve chamber. Old rings reapplied should be at least 1/16 in. larger than the valve chamber.

The cylinder should be rebored when worn 1/16 in. out of round and should be bushed when not over ¾ in. larger than the original size.

We find that on engines converted from saturated to superheated locomotives the cylinders have a tendency to crack between the valve chamber and the receiving ports of the cylinder. In order to overcome this we are applying a cross brace from front to back of it between the valve chamber and the cylinder, and drawing the metal together by shrinkage.

Piston heads should not be allowed to become more than ⅛ in. smaller than the cylinder; cylinder packing should be fitted to the cylinders; we believe that the Dunbar type of cylinder packing is the most economical for the length of service and less wear on our cylinders. Pistons should be examined at every shopping. Piston bearings in the heads and crossheads should be made with a taper of ¾ in. to 12 in. All joints in the piston packing should be ground, properly fit to cup and rods, springs and retainers measured and made proper lengths and sizes. Guides and crossheads must be kept in first class shape at all times as they control the wear and life of the cylinders, packing and pistons. Guides should be lined and squared with the bore of the cylinders. Crossheads and crosshead gibs must be kept properly fitted and machined at all times.

DISCUSSION

With the Stephenson valve gear a number of roads follow the practice of keying the eccentrics to the main axle before the wheels are under the engine. A record is kept of the position of the eccentrics so that the practice may be uniform on different engines of the same class. The Lackawanna has found trouble on superheater locomotives with the graphite lubricator because of carbonization, causing the piston rings to tilt, and blows resulting. It was stated that much trouble with valves may be eliminated by removing the relief valves and instructing the men to work steam to a stop. The practice of examining valves and piston rings periodically, generally every thirty days, seems to be quite general, but one member did not think it was necessary. He claimed that this method was too expensive and that satisfactory results could be obtained by the enginemen reporting trouble after it starts. Several members expressed the opinion that lack of lubrication was the cause of much cylinder and valve trouble where a little more oil would save much repair expense on rings and bushings. Two roads have done away with piston rod oil cups on superheater locomotives and use swabs with valve oil. This has been found to

reduce carbonization, as the enginemen, it was claimed, will use low grade oil in the oil cups and this carbonizes very easily.

AUTOGENOUS WELDING

The report of the committee on Autogenous Welding, which was presented by the chairman, C. L. Dickert, Central of Georgia, will appear in the September issue of the Railway Age Gazette, Mechanical Edition.

MAINTENANCE OF THE AIR BRAKE

BY CHAS. M. NEWMAN
General Foreman, Atlantic Coast Line, South Rocky Mount, N. C.

The position the air brake holds in relation to the present railroad traffic makes it one, if not the most, important device in use on the railroads today. The relation of the air brake to the successful handling of our present train is such that, without it, a road would be so congested in a few hours that a large percentage of its freight would perish before reaching its destination.

Accessibility of Apparatus.—As an assistance to maintenance the parts of the air brake requiring frequent attention should be accessibly located. It is a fact that when time is short and many repairs are to be made the parts most accessible will receive the attention and those inaccessible will be neglected. This results in lowering the efficiency of the brakes, in neglect of equipment and, after all, an increase in the cost of maintenance. Very often you will find brake cylinders so located, especially on locomotives, that it is necessary to remove them in order to apply a leather or gasket. Such conditions as these make maintenance expensive.

Proper Installation.—A good air brake equipment improperly installed is an expensive device from which efficient service cannot be obtained. The heart of the equipment, the air pump, should be made perfectly secure at its location, and so located that the intake will not be in a position to collect dirt and grit from the running boards or ashes from the pans when the fires are being cleaned or dumped. The air pump steam pipe should be connected to the boiler so as to insure dry steam at all times. Reservoirs and other parts which have several pipes connected to them should be fastened to some place as free from vibration as possible and the fastening should be made securely.

When a distributing valve is used, it should be applied to substantial brackets and these to a place free from vibration. Brake valves and signal valves should not be located too close to the boiler. Gages should never be fastened directly to iron brackets, but small blocks of soft wood, of a uniform thickness, should be used between the gage and the bracket. All piping should be put up with as few elbows as possible, using easy bends instead. In using a compound in fitting up air pipes, in all cases, it should be applied to the outside of the thread. When installing an air brake equipment or any part of the equipment, there are several very important facts to bear in mind:

Locate parts convenient for the repair man and the air brake operator.

Do not place parts, whose efficient operation is affected by heat, too close to the boiler.

Locate parts with pipes connected at a place free from vibration.

All parts must be free from any foreign matter before application.

Methods of Inspection.—Before any engine leaves the engine house its entire air apparatus should be given a thorough inspection and test by competent men, and all perceptible defects corrected. The air pump should be given an efficiency test to see that it is capable of supplying the necessary quantity of air under ordinary conditions. The brake levers, beams and hangers should be carefully watched, for frequently a repair man, at an outside point, will replace one of these with one that may not be of correct dimensions. The proper time to inspect a train is on its arrival. To do this, the incoming engineer should add to the reduction required to stop, enough to fully set the brakes on the train. The inspectors should be present and make an immediate examination.

Terminal test plants are a great source of convenience for making inspection and tests; they also make possible lots of repairs that otherwise could not be made without delay; still they have their objectionable features. One of the grave evils of many test plants is the excessive amount of moisture due to insufficient cooling of the air.

Terminal Repairs.—Good brakes depend on the attention they receive at the terminal and all defects noted by the inspectors should be corrected. Such repairs as ordinary brake pipe leaks, defective hose gaskets, wrong piston travel, etc., which require little time should be made on the service tracks; but cars requiring heavy brake repairs should be marked for the repair tracks. Here is where good judgment must be exercised, as perishable or other very important loads or empties needed for such lading must not be delayed.

All cars in shops or on repair tracks with cleaning dates over nine months old should have their brakes cleaned and lubricated. Not only will the condition of brake cylinders and triples fully warrant this, but it is improbable that these cars will be so favorably located again for months, without causing delay and switching. When triples need cleaning they should be removed and sent to the shops, or some place fitted with a test plant, so that, after the operation of cleaning and lubricating, they can be placed on the test rack and given the required test. If all triples are removed from the bad order cars (which every road has a supply of stored for heavy repairs) and cleaned, lubricated and tested, you will find you will have an abundance of extra triples which can be used to replace those sent to the shop for attention. When the triples are being removed from "B. O." cars or engines, the air and signal hose should also be removed and applied to other equipment in service..

Since the introduction of the large and compound pumps, which are to take care of the increased number of cars in the train, most of us have been using this increase of air to take care of our air leaks, which is not only hard on the pump but expensive from a fuel standpoint. For the sake of illustration—

A certain large railroad system, which operates long trains successfully, has an allowable maximum train line leakage as follows: For trains from 25 to 50 cars, 7 lb. per min.; for trains from 50 to 75 cars, 6 lb. per min., and for trains from 75 or over, 5 lb. per min. Our average train is from 50 to 75 cars; the allowable leakage on this train is 6 lb. per min., or about 65.5 cu. ft. of free air, which is about the capacity of our single stage 11 in. air pump. Suppose to operate an 11 in. air pump, we require 200 lb. of coal per hour, or 4,800 lb. for 24 hours; estimating the coal at $2 per ton it would cost $4.70 to pump against a 6 lb. leakage for 24 hours.

METHOD OF MAKING REPAIRS ON THE ATLANTIC COAST LINE

Air Pump Repairs.—The cylinders are calipered and if the steam cylinder is found 1/32 in. out of round or 1/32 in. smaller in diameter in the center than at either end, it is removed from the center piece and bored out. If the air cylinder is found 1/64 in. out of round or 1/64 in. larger at any place than at another, it is bored out. We bore the cylinders four times, keeping them in sizes varying by 1/16 in. After a 9½ in. cylinder has been enlarged to 9¾ in. and run to its limit for wear, it is bored to 9⅞ in. and bushed to 9 7/16 in.

The air valves are ground in and applied with the cages and caps. After the caps have been well tightened the caps and valves are tested. The pistons are turned to an easy fit in the cylinder; the rods are trued. The cylinder packing rings are purchased from the manufacturer to fit the piston groove, and vary-

ing in size to fit the cylinders, allowing 1/8 in. for spring. The rings are applied to the pistons and the pistons applied to the pump, "King Type" metallic packing being used on the rods. In repairing the pump heads, if we find the main valve bushing not true, we ream it with a special adjustable hand reamer.

The slide valves are faced on a revolving aloxite wheel to a true bearing; the seats are faced with a file and scraper using the valve as a face plate. They are then ground in using kerosene oil and carborundum grain. If the left main valve cylinder head is not reasonably true, it is discarded. If the reversing valve piston rod and bushing are not in good condition, new parts are applied. After the pump is assembled, it is placed on a test rack, and after running it several hours it is given all required tests before it is placed into service. We require twelve months ordinary service from all pumps between general repairs.

Brake Valve Repairs.—The rotary valve and seat are faced by hand, as we have not yet been able to machine them perfectly. If the bottom case bushing is not perfectly true, it is reamed with a special adjustable hand reamer. The equalizing piston packing ring is fitted to the piston groove and the cylinder. If the equalizing piston packing ring groove is worn, we close it to a template, using a specially constructed press for the operation. This effects a saving of about $0.75, as a new piston would have to be applied.

Feed Valve Repairs.—Before any repairs are made to the feed valves we thoroughly clean them, using kerosene oil, gasolene and compressed air, and place them on the test rack to locate all the defects. A good fit for the feed valve piston in the bushing is very necessary. If the bushing is not perfect, we ream it with a special adjustable hand reamer. The piston is then spread to fit the bushing, and the spider is also spread to fit its guide. These spreading devices are simple and are home-made tools which effect a saving of about $0.87, the price of a new piston.

Distributing Valve Repairs.—After dismantling, the body of the distributing valve is sent to the lye vat and placed in boiling lye water for about five minutes; if left in longer, they seem to warp and will require considerably more work to repair. All small parts are cleaned with gasolene and the valve is assembled. It is then placed on a No. 6 ET test rack and given all tests, and if no defects develop it is returned to service.

Triple Valve Repairs.—All triples sent in for repairs are first cleaned with a wire brush wheel, and all bruises removed from the gasket side with a file. The piston slide and graduating valves are placed in kerosene oil, and afterwards washed in gasolene and blown off with compressed air. The emergency valve seat is cleaned by using No. 0 emery cloth on a smooth surface. The feed groove is cleaned out with a piece of hard wood. The triple bushing is cleaned out with a piece of cheese cloth and blown out with compressed air. Never use waste in cleaning triples. The slide and graduating valves are lubricated with dry graphite. The spider end of the piston, as well as the ends of the slide valve spring, are also lubricated with dry graphite.

About three drops of anti-friction triple valve oil is applied to the cylinder bushing, spreading it evenly over the surface on the train line side of the piston. After assembling, the triple is placed on the test rack and given all tests.

All the cleaning operations are performed by handy-men on a piece work basis, except the test rack operator who is a day rate man. Any triple which fails to stand the test on account of improper work done by the cleaners, is returned to them for correction, without compensation. Triples, which, during tests, show bad bushings or leaky packing rings, leaky graduating or slide valves, are so marked and delivered to the triple valve machinists for repairs.

Brake Cylinder Repairs.—In making repairs to brake cylinders, notice should be taken of the piston fit in the cylinder. The packing leather should be soft and pliable and thoroughly lubricated with a good grease. When applying the leather and expanding ring, care should be taken to see that the ring has an even bearing on the leather, and that the leather has a smooth, even bearing on the walls of the cylinder. The follower should not clamp the expanding ring, but simply keep it in place and hold the leather to the piston.

DISCUSSION

The chief point in the discussion on this subject was that the various parts of the air brake apparatus should be located in accessible places as many times it has been found extremely difficult to make satisfactory repairs on account of the poor location of the part that was to be worked on. Vanadium steel was recommended for air brake piston rods, and it was believed that these rods should be made with the sharp taper of 2¼ in. to the foot, rather than having a shoulder in the piston fit, as they would give much better life and eliminate breakage to a great extent. A few members reported that they had workmen sufficiently expert to get a satisfactory seat on the rotary valve in a lathe without finding grinding necessary.

TAYLOR SYSTEM

BY W. W. SCOTT

General Foreman, Delaware, Lackawanna & Western, Buffalo, N. Y.

The "Taylor System" so called, is putting into effect the principles of scientific management. Methods of doing business change, and two phrases describe this gradual change in business: "Specialization-of-work" and "mass-production." Machinery has taken the place of workmen, and with this gradual change in business has come as gradually but as surely a change in methods of handling work.

The one-man business is a back number. Instead, the authority of the one man has been divided into sections; each section has been given in charge of an individual who is responsible for carrying it out, as work has grown in bigness the more has it been sub-divided into units.

Two men's names are intimately associated with this newer idea of management: F. W. Taylor and Harrington Emerson. Both have the same object. They differ principally in methods. Mr. Taylor's system offers a sub-division of the old organization and divides all work into two phases: Planning and execution. Mr. Emerson's application of scientific management is based upon twelve principles of efficiency. He retains the old organization, but a staff organization is added; specialists who plan and outline the more efficient principles for the old organization to carry out.

After a careful analysis of the scientific principles of either the Taylor or Emerson school, we may find in many of the details nothing entirely new in doing work. The shop manager may have a much better way in handling some detail, but the new principles should not be confused with methods. If you have the principles of scientific management and a purpose to carry them out, any man get results though his methods of applying the principles may vary.

Frederic M. Feiker offers these principles as the ground work upon which to build a structure dedicated to scientific management:

To separate from the "line organization" or to add to the "line organization" a staff officer or "staff organization."

To set up tentative standards of performance.

To correct these standards by working out scientifically the best methods of performance.

To determine the best inducement to the employee to attain these standards.

To equip the employee with clear, complete and exact knowledge of the best and quickest way of doing the work.

Although scientific principles of management were first applied to the operation of machine shops by Fred W. Taylor, the principles have come to be universal. They can be applied even to millinery shops with wonderful results, and they have

been successfully applied to a wide range of industrial activity.

All wage payments under scientific management are based on four principles:

A large daily task for each man in the shop.

Standard conditions. Each man's task should call for a full day's work.

High pay for success. Any man should be sure of large pay when he accomplishes a task.

Loss in case of failure; when he should be sure that sooner or later he will be the loser by it.

It will be seen there is nothing radically new in these principles, and they do not propose any mechanical method of handling the question of wage payment.

In the Bethlehem Steel Works where F. W. Taylor has put his principles of management into operation, all these methods of wage payment were employed under scientific management, but two methods proved particularly successful in introducing standard methods of work into the shop.

One, the differential piece rate system invented by Mr. Taylor; the other, the task and bonus system invented by H. L. Gantt. Of these two systems, the task and bonus system has proven to be particularly applicable in changing over from former methods to more exact and scientific methods of management in shops.

In the differential piece work system, work is paid for by the piece. Time studies form the basis for making a minimum piece-work price. The only difference between the scientific piece-work rate and that in the average shop, is that the scientific piece-work rate is based on our exact knowledge of the time for detailed operations of doing a job—not one man's judgment, or two men's judgment, of the time it ought to take to do the work, but an analysis of the exact time taken with a stop-watch by a trained investigator when different workmen work on the same job, under ideal conditions, with the best tools, the best material, and the best working arrangements that the manufacturer can supply.

The history of the development of scientific management up to date calls for a word of warning. The mechanism of management must not be mistaken for its essence or underlying philosophy. Precisely the same mechanism will in one case produce disastrous results, and in another the most beneficent. The same mechanism which will produce the finest results when made to serve the underlying principles of scientific management, will lead to failure and disaster if accompanied by the wrong spirit in those who are using it.

Mr. Taylor, in his paper on "Shop Management," has called special attention to risks which managers run in attempting to change rapidly from the old to the new management. The philosophy of scientific management is contained in four underlying principles:

The development of a true science; the scientific selection of the workmen; his scientific education and development; intimate friendly co-operation between the management and the men; in other words substitute science for the rule of thumb; harmony for discord, co-operation, not individualism, maximum out-put in place of restricted out-put and the development of each man to his greatest efficiency and prosperity.

OTHER BUSINESS

J. Hannahan, formerly chief of the Firemen's Brotherhood and now a representative of the Locomotive Stoker Company, addressed the association, pointing out to the members the necessity of all railroad men working together to prevent so much adverse legislation that has proved to be merely political ammunition. Every railroad man should exert what influence he can to impress his representatives in either the state or federal legislatures, that they should treat the railroads fairly. He also spoke of the vast opportunities ahead of general foremen, mentioning a number of prominent men who have worked up through this position.

The following officers were elected for the ensuing year: President, W. W. Scott, general foreman, D. L. & W., Buffalo, N. Y.; first vice-president, L. A. North, superintendent of shops, Illinois Central, Chicago; second vice-president, Walter Smith, Chicago & North Western, Chicago; third vice-president, W. T. Gale, machine foreman, Chicago & North Western, Chicago; fourth vice-president, W. G. Reyer, general foreman, Nashville, Chattanooga & St. Louis, Nashville, Tenn.; secretary-treasurer, Wm. Hall, Chicago & North Western, Winona, Minn. The secretary reported a membership of 219 and a cash balance of $68.25.

The executive committee met immediately after the adjournment of the convention and chose the following subjects for the next annual convention: Valves and Valve Gearing, Rods, Tires, Wheels, Axles and Crank-Pins; Shop Efficiency; Oxy-Acetylene Welding; and Roundhouse Efficiency. The convention for 1915 will be held in Chicago some time during the month of July.

DISTRIBUTION OF ENERGY IN A LOCOMOTIVE AND IN ANIMALS

BY PROF. ARTHUR J. WOOD
The Pennsylvania State College

A comparison of one locomotive with another on the basis of efficiency, economy or performance often leads to better designs. As methods of testing become more and more refined, such comparisons have new interest and importance. In the modern locomotive testing plant, it is possible to account for the losses of heat when the coal is burned in the firebox and during the various transfers of heat in the boiler, cylinder and driving mechanism, until finally it is found that from four to seven per cent of the heat energy in the fuel is used at the track to haul the load.

In the same general way, by putting an animal in a calorimeter, corresponding to the testing plant, it is possible to account for the various losses in feeding stuffs, as hay, bran and grain. This calorimeter is essentially an insulated, enclosed stall into which a measured quantity of air, food and water may be supplied and is so arranged that an accurate accounting may be made of the quantity and quality of gases and refuse and of the heat given off by the animal placed therein; and finally of the amount of energy consumed or rejected during the different processes of assimilation and nutrition. It is thus possible to account for the energy finally recovered and available for simple locomotion of the body and in hauling a load. From such a study, we find that the animal, classed purely as a machine, is capable of using energy in the fuel supplied from five to ten times as efficiently as is possible in a modern locomotive. This should not be taken as meaning that according to our usual standards, the locomotive is not an efficient machine. Regarded as a power plant, its efficiency under favorable conditions compares favorably with that of a stationary power plant of the same output using reciprocating engines.

For many years there has been in operation at the Pennsylvania State College the only complete animal calorimeter in this country. The investigations cover a large range of feeding stuffs and the results are important. Dr. H. P. Armsby, Director of the Institute of Animal Nutrition at the college, has brought together for this study the results of some of these tests. The figures here given apply to steers, cows and sheep, but not to horses or hogs. In the case of a draft horse, he states that about 31 per cent of the available energy can be recovered as useful work.

The values for the locomotive are given in round numbers and were calculated by the writer from data from locomotive testing plant results of a large Pacific type locomotive, stoker fired, with a superheater and burning Penn Gas coal. While no absolute comparison can be made between the energy rejected and recovered by the animal and by the locomotive, still the anology in the case should be quite apparent.

An essential difference in this comparison is that the animal is not a heat producing machine and therefore the energy of digestion is not determined by ranges of temperatures. Taking the mixed grain as an average of the four feeding stuffs, it may be noted that 37.5 per cent of the energy supplied is available to the body for locomotion and for work. The losses in this case in the feces is less than a half of what it is for timothy hay per pound. The fuel (hay) is not as well "burned" as is the grain, but the two have nearly the same heat value per pound.

PERCENTAGE DISTRIBUTION OF ENERGY OF FEEDING STUFFS

	Timothy		Wheat bran		Mixed grain		Corn meal	
1—Energy of feed as consumed		100.00		100.00		100.00		100.00
2—Energy rejected unused in excreta:								
(a) In feces	46.38		31.51		20.04		9.21	
(b) In urine	3.67		5.42		6.86		3.83	
(c) In combustible gases	6.75	56.80	7.36	44.29	7.95	34.85	9.30	22.34
3—Energy liberated in body		43.20		55.71		65.15		77.66
4—Energy expended in digestion and converted into heat		18.88		24.88		27.70		23.98
5—Energy available to the body		24.32		30.83		37.45		53.68

PERCENTAGE DISTRIBUTION OF ENERGY OF DRY COAL IN LOCOMOTIVES

1—Energy of feed (fuel) as consumed		100.00
2—Energy rejected unused—		
(a) In ashes, sparks, radiation and unaccounted for	21.0	
(b) In water vapor and heating water	5.5	
(c) In unburned combustible gases	18.0	44.5
3—Energy liberated in the body of the locomotive		55.5
4—Energy expended in boiler and cylinders and converted into heat*		49.0
5—Energy available to do work		6.5

*This energy is not available to do work at the track.

Note also that the energy "liberated in the body of the locomotive" is about the same as the energy "liberated in the body" of the animal, but that the energy expended and converted into heat in the latter case is twice as much as in the former, a significant fact in the study of the betterment of the man-made machine.

If one will consider for a moment it will become evident that the locomotive works thermodynamically at a disadvantage when compared with the animal power plant in that the temperatures in the animal are not over 102 deg. F., so that the conduction and radiation factors are relatively low. Again, there is no comparison possible with steam cylinders, where the highest possible efficiency is limited by the temperatures of the vapor in the ratio $(T_1 - T_2) \div T_1$ where T_1 is the absolute initial and T_2 the absolute final temperature. This ideal efficiency in a reciprocating engine seldom exceeds 35 per cent. On the other hand, high ranges of temperature are essential to high efficiency during expansion, indicating that the animal's over-all efficiency is high notwithstanding this thermal disadvantage.

From any standpoint, the study leads to the conclusion that the created organism far excels the man-made machine on the basis of the energy available to do work.

ALUMINUM FOIL.—The manufacture of aluminum foil is a growing industry of southwestern Germany. The foil is used in place of tin foil for wrapping candied fruit, and the like, possessing several advantages over the tin.—*The Engineer.*

ELECTRICITY TO PREVENT FREEZING.—By keeping currents of several hundred amperes flowing continuously through water pipes which otherwise would have been in danger of freezing, it was possible to continue construction work on a hydro-electric development on the St. Lawrence river without interruption during even the coldest days of the past winter. The one inch pipes thus protected supplied water for the steam shovels and were laid above ground, as continuous shifting prevented them from being buried.

ELECTRIC LOCOMOTIVE DATA

BY F. D. EVERETT

The accompanying tables give complete data on many types of electric locomotives in heavy railway service in this country and abroad. One may see at a glance the general characteristics of the types preferred by the different railroads.

In Table I information is grouped concerning 8 American and 17 European single phase locomotives.

Table II covers 12 direct current locomotives of American and 3 of European manufacture. Two of the European are not for main line service, but are given because constructed for direct current at 3,000 and 2,000 volts respectively. The third was for use in Canada.

Table III contains data for 5 foreign and one American 3-phase locomotives, while Table IV deals with the locomotives using current of a different sort in the motors from that collected by the trolley.

Thus it is seen that only in this country has direct current been used for heavy electric traction. Abroad the higher direct current voltages have been employed on interurban lines with multiple unit car service, but have not been tried on main line work. Italy uses the three-phase system for its advantages on heavy grades, while the other countries prefer single-phase with 10,000 to 15,000 volts on the trolley and a frequency of 15 or 16⅔ cycles.

The differences between American and European design are well brought out by these tables. On this side the prevailing method is to use a gearless or single reduction geared drive with one or two motors per driving axle, thus keeping down the size and capacity of the motors. Abroad the custom is to use coupled driving axles driven from a countershaft which is connected to one or more large motors by cranks and connecting rods, or by yokes or gearing. This use of gearing between motor and countershaft is only to be found on the newest locomotives. Flexibility is given the long wheel base of coupled axles by allowing the outer driving axles a certain amount of end play or by even using flangeless wheels on the middle axle as in the latest Löetschberg locomotive. The foreign design was perhaps influenced in the use of side rod drive by the fact that these were specified for the first German locomotives by the government railway officers who thought by this type of construction to reduce complication and keep the running gear as similar as possible to that of steam locomotives. The geared countershaft is the drive preferred by the foreign designers and has been accepted by Prussian government officers as satisfactory.

The only exceptions in the United States to the general American practice are the new Norfolk & Western and the Pennsylvania locomotives. The latter road chose the side rod drive in order to obtain the high center of gravity which their tests had shown to be so essential for preservation of the road bed. The Vienna City 3,000-volt, three-wire locomotive used a geared drive of two motors per axle. The Paris, Lyons & Mediterranean locomotive had a bevel gear drive with the motors placed lengthwise of the body.

Table V gives the average values of weight per horse power and maximum starting tractive effort per 100 lb. of adhesive weight. The three-phase locomotive is the lightest per horse power and has the greatest available starting tractive effort per 100 lb. of adhesive weight. The Great Northern placed extra ballast weights on the locomotive in order to utilize the full starting power of the motors. Likewise in the Giovi locomotives provision has been made to increase the weight from 132,000 lb. to 165,000 lb. if (in the future due to increase of train length) the full starting torque of the motors is needed.

American single-phase locomotives average around 180 lb. per horse power, but as most of these are equipped for direct current as well as alternating current operation and have train

TABLE I

Road	Supply: Volts	Supply: Freq.	Type of service	Placed in operation	Manufacturer	Type of drive	Wheel arrangement	Drivers, diam. in inches	Length: Ft.	Length: In.	Wheel base Total: Ft.	Wheel base Total: In.	Wheel base Rigid: Ft.	Wheel base Rigid: In.	Number of motors	Total H. P.: 1 hour rate	Total H. P.: Continuous
N. Y. N. H. & H.	11,000	25	Pass and frt.	1906	Westinghouse	Gearless (quill)	0—4—4—0	62	36	4	22	6	7	6	4	1,000	800
N. Y. N. H. & H.	11,000	25	Pass and frt.	1909	Westinghouse	Gearless (quill)	2—4—4—0	62	36	4	30	10	11	8	4	1,000	800
N. Y. N. H. & H.	11,000	25	Freight	1910	Westinghouse	Geared (quill)	2—4+4—2	63	48	..	38	6	7	..	4	1,400	1,200
N. Y. N. H. & H.	11,000	25	Pass and frt.	1912	Westinghouse	Geared (quill)	2—4+4—2	63	50	..	40	6	8	..	8	1,360	1,160
N. Y. N. H. & H.	11,000	25	Switching	1911	Westinghouse	Geared (quill)	0—4+4—0	63	37	..	23	6	7	..	4	770	500
Grand Trunk	3,000	25	Pass and frt.	1908	Westinghouse	Geared	0—6—0	62	23	6	16	..	16	..	3	750	.....
Boston & Maine	11,000	25	Pass and frt.	1911	Westinghouse	Geared (quill)	2—4+4—2	63	48	..	38	6	7	..	4	1,400	1,200
Pennsylvania	11,000	15	Passenger	1907	Westinghouse	Gearless (quill)	4—4+4—4	72	62	..	55	10	7	6	4	2,000	1,500
Loetschberg	15,000	15	Pass. and frt.	1911	Oerlikon	Geared countershaft	0—6+6—0	53	49	6	35	2	13	4	2	3,000	2,000‡
Loetschberg	15,000	15	Pass. and frt.	1913	Oerlikon	Geared countershaft	2—10—2	53	52	6	37	2	14	9	2	.....	2,500‡
Dessau-Bitterfeld	10,000	15	Passenger	1910	A. E. G.	Side rod and jack shaft.	4—4—2	63	41	..	29	6	9	10	1	1,000	700
Dessau-Bitterfeld	10,000	15	Freight	1910	Siemans-Schuckert.	Side rod and jack shaft.	0—8—0	41.4	34	6	15	9	7	3	1	800	600
Lauban-Konigzelt	10,000	15	Pass. and frt.	1913-14	Brown-Boveri Cie.	Geared	0—6+6—0	..	..	..	..	..	..	..	4	1,500	1,200
Lauban-Konigzelt	10,000	15	Freight	1913	Siemans-Schuckert.	Geared c. shaft	0—4+4+4—0	53	56	6	44	6	9	6	3	1,500	1,200
Lauban-Konigzelt	10,000	15	Pass. and frt.	1912	Siemans-Schuckert.	Side rod and jack shaft.	2—8—2	45.3	46	5	34	10	8	2	1	1,700	.....
Magdeburg-Leipzig-Halle	10,000	15	Pass. and frt.	1912	A. E. G.	Geared c. shaft	0—4+4—0	53	36	10	26	2	9	6	2	1,000	600
Magdeburg-Leipzig-Halle	10,000	15	Pass. and frt.	1912	Maffei-Schwarzkopf.	Side rod and jack shaft.	2—6—2	63	43	..	31	6	..	..	1	1,800	1,100
Wiesental	10,000	15	Pass. and frt.	1912	Brown, Boveri & Cie	Scotch yoke	2—6—2	59	39	2	28	2	15	8	2	950	780
Wiesental	10,000	15	Pass. and frt.	1910	Siemans-Schuckert.	Side rod and 2 shafts	2—6—2	47	43	2	31	2	11	6	2	950	780
Midi	12,000	16⅔	Pass. and frt.	1911	A. E. G.	Side rod and 2 shafts	2—6—2	51	43	..	31	6	11	10	2	1,600	1,200
Midi	12,000	16⅔	Pass. and frt.	1911	French Westingh'se	2 geared c. shafts	2—6—2	47	37	3	28	11	13	2	2	1,200	.....
Midi	12,000	16⅔	Pass. and frt.	1911	Jeumont	Geared (quill)	2—6—2	55	46	9	34	10	12	6	3	1,500	1,200
Valle-Maggia	5,000	20	Mountain	1911	Oerlikon	Geared c. shaft	0—4—0	..	21	6	10	10	10	10	1	250	.....
Swedish Rys.	15,000	15	Passenger	1912	Siemans-Schuckert.	Side rods and c. shaft	4—4—4	62	42	4	32	6	..	..	1	1,250	740
Swedish Rys.	15,000	15	Freight	1912	Swedish A. E. G.	Side rods and c. shaft	0—6+6—0	47.5	52	..	38	5	..	..	2	1,660	1,100

Road.	Tractive effort: Maximum	Tractive effort: Hourly	Tractive effort: Continuous	Weight in lb.: Total	Weight in lb.: On drivers	Max. speed, m.p.h.	Speed at cont. rating	T. E. in per cent. of adhesive wt.: Max.	T. E. in per cent. of adhesive wt.: Cont.	Lb. wt. per 1 hr. H.P.	T. E. per H. P.: Max. 1 hr.	T. E. per H. P.: Cont. cont.	Reference
N. Y. N. H. & H.	20,000	10,000	7,500	180,000	180,000	70	40	11.1	4.2	180	20	9.4	St. Ry. Jour., Vol. 27, p. 588; Vol. 130, p. 278.
N. Y. N. H. & H.	20,000	10,000	7,500	204,500	154,000	70	45	13.0	4.8	205 (196)†	20	9.4	Ry. Age Gaz., Vol. 45, p. 1472.
N. Y. N. H. & H.	40,000	14,000	12,000	260,000	188,000	50	35	21.3	6.4	186 (172)†	28.5	10	El. K. u. B., 1909, p. 574.
N. Y. N. H. & H.	40,000	14,000	12,000	240,000	182,000	50	45	22.0	6.6	176	29.4	10.3	Ry. Age Gaz., Vol. 52, p. 1608.
N. Y. N. H. & H.	36,000	......	14,800	158,000	158,000	26	11.5	22.8	9.4	206	46.8	29.6	Ry. Age Gaz., Vol. 51, p. 118.
Grand Trunk	43,600	......	7,000	132,000	132,000	35	25	33.0	5.3	176	58.0	....	Ry. Age Gaz., Vol. 45, p. 1346.
Boston & Maine	49,000	25,000-F 14,000-P	21,400 12,000	260,000	192,000	45-F 50-P	21-F 38-P	25.6	11.2-F 6.2-P	186	35	17.8-F 10.0-P	Am. Engr. & Ry. Jour., Nov., 1911.
Pennsylvania	40,000	14,700	9,200	280,000	200,000	....	61	20	4.6	140	20	6.1	R. R. Gaz., Nov. 22, 1907.
Loetschberg	33,000*	28,600*	22,000*	198,000	198,000	43.5	26.1	16.7	11.1	99	16.5	11.0	El. Ry. Jour., Vol. 38, p. 190.
Loetschberg	39,600	29,700‡	22,200	236,000	172,000	46.5	31	23	12.9	95	15.9	8.9	El. Ry. Jour., Vol. 42, p. 1048.
Dessau-Bitterfeld	19,000	11,000	4,180	132,000	61,500	68	53	31	6.8	132	19	6.0	El. Kraft u. Bahn, Vol. 8, p. 281.
Dessau-Bitterfeld	22,000	19,800	......	123,000	123,000	44	....	17.9	....	153	27.5	....	Eng. News, Vol. 66, p. 554.
Lauban-Konigzelt	36,300	......	20,900	....	....	28	12.4	....	....	...	24.2	17.4	Ry. Gazette (London), Oct. 4, 1912.
Lauban-Konigzelt	36,300	......	20,900	185,000	185,000	28	12.4	19.6	11.3	123	24.2	17.4	El. K. u. B., Vol. XI, p. 112.
Lauban-Konigzelt	39,600	19,800	......	203,000	141,000	62	50	28	....	120	23.2	....	El. K. u. B., Vol. XI, p. 112.
Magdeburg-Leipzig-Halle	26,400	......	......	....	....	40.4	21.7	....	....	...	26.4	....	Ry. Gazette (London), Oct. 4, 1912.
Magdeburg-Leipzig-Halle	17,600*	11,000	6,610	156,000	99,000	68.4	56	17.8	6.7	87	9.8	6.0	El. Ry. Jour., Vol. 38, p. 957.
Wiesental	19,900	8,800	6,600	141,000	92,500	....	46	21.5	7.2	148	21	8.5	Le Genie Civil, Vol. 58, p. 347.
Wiesental	17,640	8,820	6,600	150,000	92,500	....	46	19.1	7.2	158	18.5	8.5	El. Ry. Jour., Vol. 35, p. 668.
Midi	27,400*	17,600*	9,240	180,000	119,000	46.5	37.2	23	7.7	112	17.1	7.7	Le Genie Civil, Vol. 58, p. 347.
Midi	27,500	17,600	9,240	178,000	119,000	....	37.2	23.1	7.7	148	22.9	....	Le Genie Civil, Vol. 58, p. 347.
Midi	27,500	17,600	9,240	176,000	119,000	....	37.2	23.1	7.7	117	18.3	7.7	Le Genie Civil, Vol. 58, p. 347.
Valle-Maggia	7,980	......	......	45,800	45,800	25	....	17.4	....	183	....	....	Schweiz, Bou., July 15, 1911.
Swedish Rys.	......	6,850	4,300	154,000	66,000	62	62	....	6.5	123	....	5.8	El. Ry. Jour., Vol. 37, p. 788.
Swedish Rys.	......	18,800	11,300	218,000	218,000	37	31	....	5.2	131	....	10.3	El. Ry. Jour., Vol. 37, p. 788.

‡ 1½ hour rating. * Drawbar pull. † Excluding direct current control and heating equipment.

TABLE II

Road	Supply: Volts	Supply: Freq.	Type of service	Placed in operation	Manufacturer	Type of drive	Wheel arrangement	Drivers, diam. in inches	Length Ft.	Length In.	Wheel base Total Ft.	Wheel base Total In.	Wheel base Rigid Ft.	Wheel base Rigid In.	Number of motors	Total H. P. 1 hour rate	Total H. P. Continuous
N. Y. C. & H. R.	600	3d rail	Passenger	1906	G.E. Co. & Am. Loco.	Gearless	2—8—2	44	37	..	27	..	13	..	4	2,200	990
N. Y. C. & H. R.	600	3d rail	Passenger	1907-08	G.E. Co. & Am. Loco.	Gearless	4—8—4	44	43	..	36	..	13	..	4	2,200	990
N. Y. C. & H. R.	600	3d rail	Passenger	1913	G.E. Co. & Am. Loco.	Gearless	0—4—4+4—4—0	36	55	2	45	1	6	6	8	2,000	1,600
N. Y. C. & H. R.	600	3d rail	Passenger	1913	G.E. Co. & Am. Loco.	Gearless	0—4—4+4—4—0	36	55	2	45	7	6	6	8	2,600	2,000
Pennsylvania	600	3d rail	Passenger	1909	Westinghouse	Side rods and c. shaft	4—4+4—4	68	64	11	55	11	7	2	2	2,500	.....
Detroit Tunnel	600	3d rail	Pass. and frt.	1909	G. E. Co.	Twin gearing	0—4+4—0	48	39	6	27	6	9	6	4	1,450	1,200
Baltimore & Ohio	600	3d rail	Pass. and frt.	1910	G. E. Co.	Twin gearing	0—4+4—0	50	39	6	27	6	9	6	4	1,450	1,200
Brit. Co. Ry.	600	Trolley	Freight	1912	Dick, Kerr & Co.	Geared	0—4+4—0	42	31	..	24	6	8	..	4	650	384
Brit. Co. Ry.	600	Trolley	Freight	1912	Westinghouse	Geared	0—4+4—0	36	31	..	22	4	6	8	4	600	250
Fort Dodge, Des Moines & So.	600/1,200	Trolley	Freight	1912	G. E. Co.	Geared	0—4+4—0	..	31	..	22	4	6	10	4	400	.....
Southern Pacific	1,200/1,500	Trolley	Freight	1912	Westinghouse	Geared	0—4—4—0	36½	35	..	25	..	7	4	4	1,000	.....
Piedmont Tr. Co.	1,500	Trolley	Freight	1912	Westinghouse	Geared	0—8—0	37	35	..	25	..	7	4	4	.....	.....
Butte, Anaconda & Pacific	2,400	Catenary	Frt. and pass.	1913	G. E. Co.	Twin gearing	0—4+4—0	46	37	4	26	..	8	8	4	1,250	1,050
Vienna City	3,000 (3 wire)	..	Freight	1907	....	Geared	0—4—0	..	..	..	..	..	..	..	4	520	.....
Moselhütte	2,000	Catenary	Ore*	1906	Siemans-Schuckert	Geared	0—4—4—0	49.3	34	2	32	9	8	6	4	640	.....

Road.	Tractive effort: Maximum	Tractive effort: Hourly	Tractive effort: Continuous	Weight in lb.: Total	Weight in lb.: On drivers	Max. speed, m.p.h.	Speed at cont. rating	T. E. in per cent. of adhesive wt.: Max.	T. E. in per cent. of adhesive wt.: Cont.	Lb. wt. per 1 hr. H.P.	T. E. per H. P.: Max. 1 hr.	T. E. per H. P.: Cont. cont.	Reference
N. Y. C. & H. R.	32,000	20,400	6,000	190,000	140,000	75	60	22.9	4.3	86.5	14.5	6.1	Ry. Gaz., Vol. 40, p. 653; El. Ry. Jour., Vol. 32.
N. Y. C. & H. R.	32,000	20,400	6,000	230,000	140,000	75	60	22.9	4.3	105	14.5	6.1	Ry. Age Gaz., Vol. 46, p. 1526.
N. Y. C. & H. R.	......	13,500	9,500	200,000	200,000	..	60	....	4.8	100	....	5.9	G. E. Review, May, 1913.
N. Y. C. & H. R.	......	20,000	14,000	220,000	220,000	..	60	....	6.3	86	....	7.0	El. Ry. Jour., Nov. 8, 1913.
Pennsylvania	69,200	25,000	15,000	332,100	208,000	88	60	33.3	7.2	133	27.7	....	Ry. Age Gaz., Vol. 47, p. 881.
Detroit Tunnel	60,000	35,400	11,200	199,000	199,000	35	22	30	5.6	137	41.4	9.3	Ry. Age Gaz., Vol. 47, p. 320.
Baltimore & Ohio	46,000	26,300	8,300	180,000	180,000	50	30	25.6	4.6	124	31.7	6.9	El. Ry. Jour., Vol. 36, p. 1067.
Brit. Co. Ry.	25,000	16,000	8,000	112,000	112,000	..	18	22.3	7.4	172	38.5	20.8	Ry. Gaz., March 8, 1912.
Brit. Co. Ry.	26,000	12,800	6,800	90,000	90,000	..	....	28.9	7.5	150	43.3	27.2	El. Ry. Jour., Vol. 39, p. 37.
Fort Dodge, Des Moines & So.	24,000	10,600	8,000	85,000	85,000	..	14‡	28.2	9.4	213	60.0	....	El. Ry. Jour., Vol. 39, p. 826.
Southern Pacific	30,000	21,600	11,500	120,000	120,000	..	17.6‡	25	9.6	120	30	....	El. Ry. Jour., Vol. 39, p. 592.
Piedmont Tr. Co.	27,000	......	13,700	110,000	110,000	..	20.5	24.6	12.4	...	....	....	Ry. & Loc. Eng., June, 1910.
Butte, Anaconda & Pacific	48,000	30,000	25,000	160,000	160,000	45	21	30	15.6	128	38.4	28.5	El. Ry. Jour., Vol. 41, p. 1010.
Vienna City	......	......	......	60,000	60,000	..	....	....	....	116	....	....	El. Review, 1907, p. 176.
Moselhütte	......	......	......	121,000	121,000	..	....	....	....	189	....	....	El. K. u. B., Vol. 5, pp. 565 and 585.

* 16.2 km. of single track, 1 meter gage. ‡ Speed at hour rating.

TABLE III

Location	Supply: Volts	Supply: Freq.	Type of service	Placed in operation	Manufacturer	Type of drive	Wheel arrangement	Drivers, diam. in inches	Length Ft.	Length In.	Wheel base Total Ft.	Wheel base Total In.	Wheel base Rigid Ft.	Wheel base Rigid In.	Number of motors	Total H. P. 1 hour rate	Total H. P. Continuous
Simplon	3,000	15	Pass. and frt.	1908	Brown-Boveri	Scotch yoke	0—8—0	49.3	38	2	26	3	15	..	2	1,700	1,100
Simplon	3,000	15	Pass. and frt.	1906	Brown-Boveri	Scotch yoke	2—6—2	64.5	40	4	31	5	16	..	2	1,150	900
Valtellina	3,000	15	Pass. and frt.	1908	Ganz El. Co.	Side rods	2—6—2	60	37	10	31	2	15	5	2	1,500 } 1,200 }	.....
Valtellina	3,000	15	Passenger	1905	Ganz El. Co.	Side rods	2—6—2	59	37	10	31	2	15	5	2	1,200	800
Giovi	3,000	15	Pass. and frt.	1910	Italian Westinghouse	Scotch yoke	0—10—0	42	43	3	20	1	12	7	2	1,440	.....
Great Northern	6,600	25	Pass and frt.	1908-09	G. E. Co.	Twin gearing	0—4+4—0	60	44	2	31	9	11	..	4	1,900	1,600

Location.	Tractive effort: Maximum	Tractive effort: Normal at different speeds	Weight in lb.: Total	Weight in lb.: Adhesive	Speeds, m.p.h.	Speed control	Max. cont. T. E. in per cent. of adhesive wt	Lb. per 1 hr. H. P.	Reference
Simplon	......	24,600—21,800 16,100—13,200	150,000	150,000	16-22-32-44	Pole changing	16.4	88	Le Genie Civil, Vol. 55, p. 201.
Simplon	30,800	13,200, 7,700	136,500	92,500	22-44	Pole changing	14.3	118	Le Genie Civil, Vol. 48, p. 305.
Valtellina	......	13,200, 7,700, 7,700	136,500	92,500	16-26-40	2 motors of different number of poles	14.3	91 or 114	El. Review, Vol. 52, p. 989.
Valtellina	26,500	13,000—7,000	124,000	84,000	20-40	Cascade and resistance	15.4	103	El. Review, Vol. 46, pp. 332 and 1008.
Giovi	......	19,500 (1 hr.)	132,000	132,000	19-28	Cascade and water resistance	14.7	92	Eng'ng News, Vol. 65, p. 510.
Great Northern	80,000	47,600 (1 hr.) 37,400 (Cont.)	230,000	230,000	15	Resistance	16.2	120*	A. I. E. E., Nov., 1909.

* Locomotive ballasted to give sufficient adhesion for maximum tractive effort.

TABLE IV

Road	Supply: Volts	Supply: Freq.	Type of service	Placed in service	Manufacturer	Type of drive	Wheel arrangement	Drivers, diam. in inches	Length: Ft.	Length: In.	Wheel base, Total: Ft.	Wheel base, Total: In.	Wheel base, Rigid: Ft.	Wheel base, Rigid: In.	Number of motors	Total H. P.: 1 hour rate	Total H. P.: Continuous
Paris, Lyons & Mediter....	13,000	25	Pass. and frt..	1911	Auvert-Ferrand	Bevel gearing	4—4+4—4	57	67	9	55	6	7	10	4	1,600	.....
Paris, Lyons & Mediter....	13,000	25	Pass. and frt..	....	Auvert-Ferrand	Side rods and c. shaft..	2—8—2	..	49	10	..	..	..	..	1	2,000	.....
Norfolk & Western........	11,000	25	Freight	1914	Westinghouse	Geared c. shaft.........	2—4+4—2	..	52	..	43	..	11	..	4	2,000 at 28 m.p.h.	1,650 at 14 m.p.h.

Road.	Tractive effort: Maximum	Tractive effort: Hourly	Tractive effort: Continuous	Weight in lb.: Total	Weight in lb.: Adhesive	Max. speed, m.p.h.	Cont. speed, m.p.h.	Type of current converter	Max. T. E. in per cent. of adhesive wt	Lb. per 1 hr. H. P.	Reference
Paris, Lyons & Mediter....	21,560	......	17,600	299,200	158,000	..	37	Permutator	13.6	187	Le Genie Civil, Vol. 58, p. 349.
Paris, Lyons & Mediter....	......	28,160	......	210,000	158,000	47	26	Permutator	17.9‡	105	El. Ry. Jour., Vol. 38, p. 386.
Norfolk & Western.........	62,500	......	33,600	260,000	228,000	28	14	Phase splitter	27.4	130 157.5	El. Ry. Jour., Vol. 42, p. 650.

‡ 1 hour H. P. tractive effort used.

heating boilers, the average weight might fairly be considered as some 10 lb. per horse power less; still, they would even then weigh much in excess of the European locomotives.

Unfortunately there are insufficient data to be able to determine the average weight per horse power of the split phase or permutator locomotives. They probably will weigh no more than the single-phase ones.

TABLE V

	Lb. wt. per H.P.	Lb. T. E. available for starting per 100 lb. adhesive wt.
Single phase (American)...............	180	21
Single phase (European)...............	130	21
Direct current	120	27
Three phase	100	33
Converter locomotives	...	27

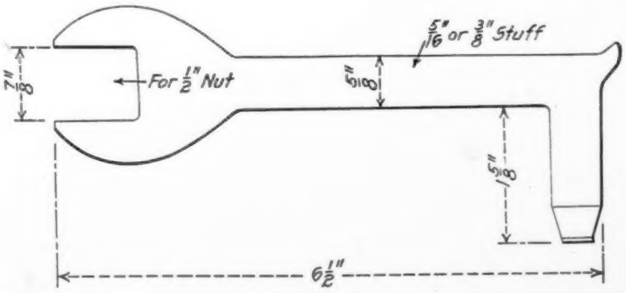
It is interesting to compare the latest New York Central direct current locomotive with the latest single-phase Löetschberg machine. The former has an hourly rating of 2,600 h. p., as compared with the latter's 2,500 h. p. for 1½ hour rating. The weights per horse power are 86 and 95 lb. respectively, the Löetschberg locomotive being 8 tons heavier in total weight, but with 24 tons less adhesive weight. The length of the New York Central locomotive is slightly in excess of that of the foreign ones.

In column headed Wheel Arrangement, the end figures denote the number of pilot wheels and the other figures give the number of drivers per truck, while the sign + indicates an articulated coupling between trucks. The reference given in the last column contains most of the tabulated data and at the same time gives a more detailed account of the construction and control.

COMBINATION TOOL FOR REPAIRING E-T DISTRIBUTING VALVES

BY F. W. BENTLEY, JR.

In the hurry of air brake running repair work there is one aggravating feature in connection with the removal of cover screws from the application portion of the distributing valve. The distributing valve on many of the larger locomotives is located so close to the reverse lever fulcrum casting that it is impossible to work with a screw driver on the cover screws. While the screws may be reached with the driver, the necessarily



Combination Wrench and Screw Driver for Use on Distributing Valves

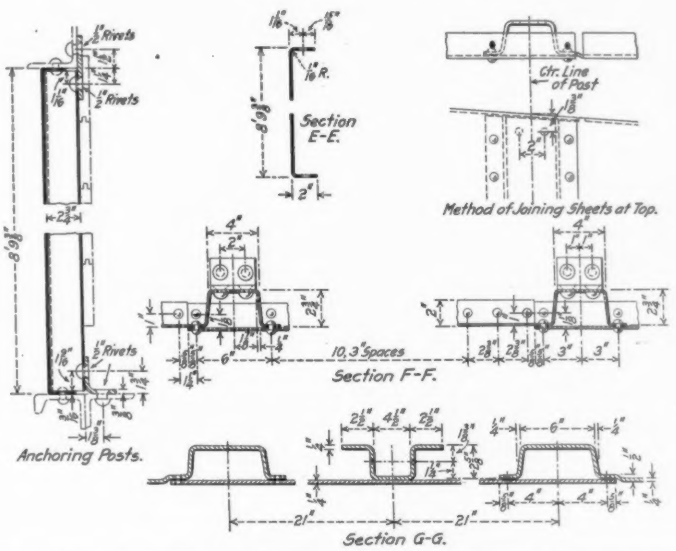
tipped position of the tool prevents the application of any great amount of force, and at the same time will quickly ruin the head of the screw.

The drawing shows a combination wrench and screw driver which has been used with considerable success. The nature of the driver end permits the application of a direct turning force to the head of the screw without damaging it, as the shank of the driver can be held down in the head slot. The handle end comprises a ½ in. wrench for use on the bolts of the application piston and equalizing heads. The wrench is easily blocked out and forged, and will be found very useful in connection with hurried work on the distributing valve.

PENNSYLVANIA STEEL BOX CAR

Wood Is Used for the Floor and Lining and the Roof Sheets Are Spot Welded to the Carlines

Following along the lines of eventually having all of its freight cars of the all-steel type, a car, the framing of which can be used practically without change for either box, stock or refrigerator cars was designed in the mechanical engineer's office of the Pennsylvania Railroad in 1912 and a large number of them



Structural Details; the References Are to the General Arrangement Drawing

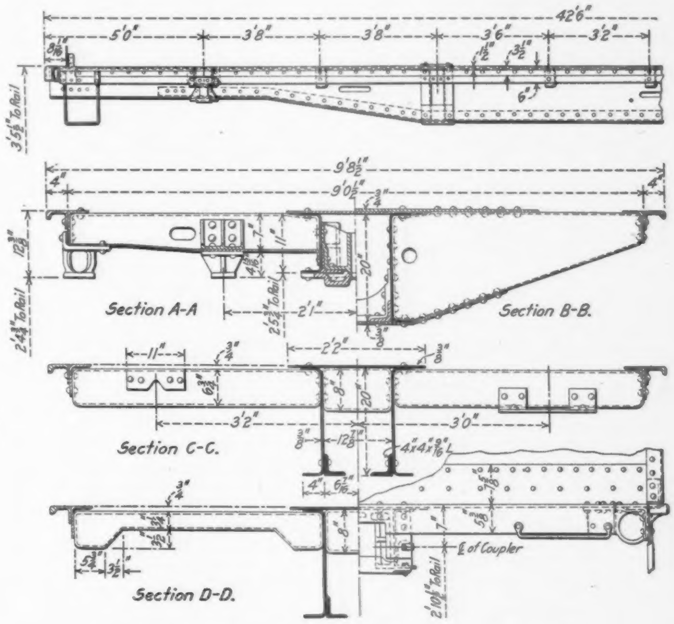
have since been built.* The most recent design of box car on the Pennsylvania, which is designated as class X 25, is constructed entirely of steel with the exception of a wooden floor and 7/8 in. wooden lining. This car, when mounted on arch bar trucks with 5½ in. by 10 in. journals, weighs 49,100 lbs.†

*For description of these cars see *American Engineer*, October, 1912, page 502.

†A brief description of this car was published in the *Daily Railway Age Gazette* for June 15, 1914, page 1412.

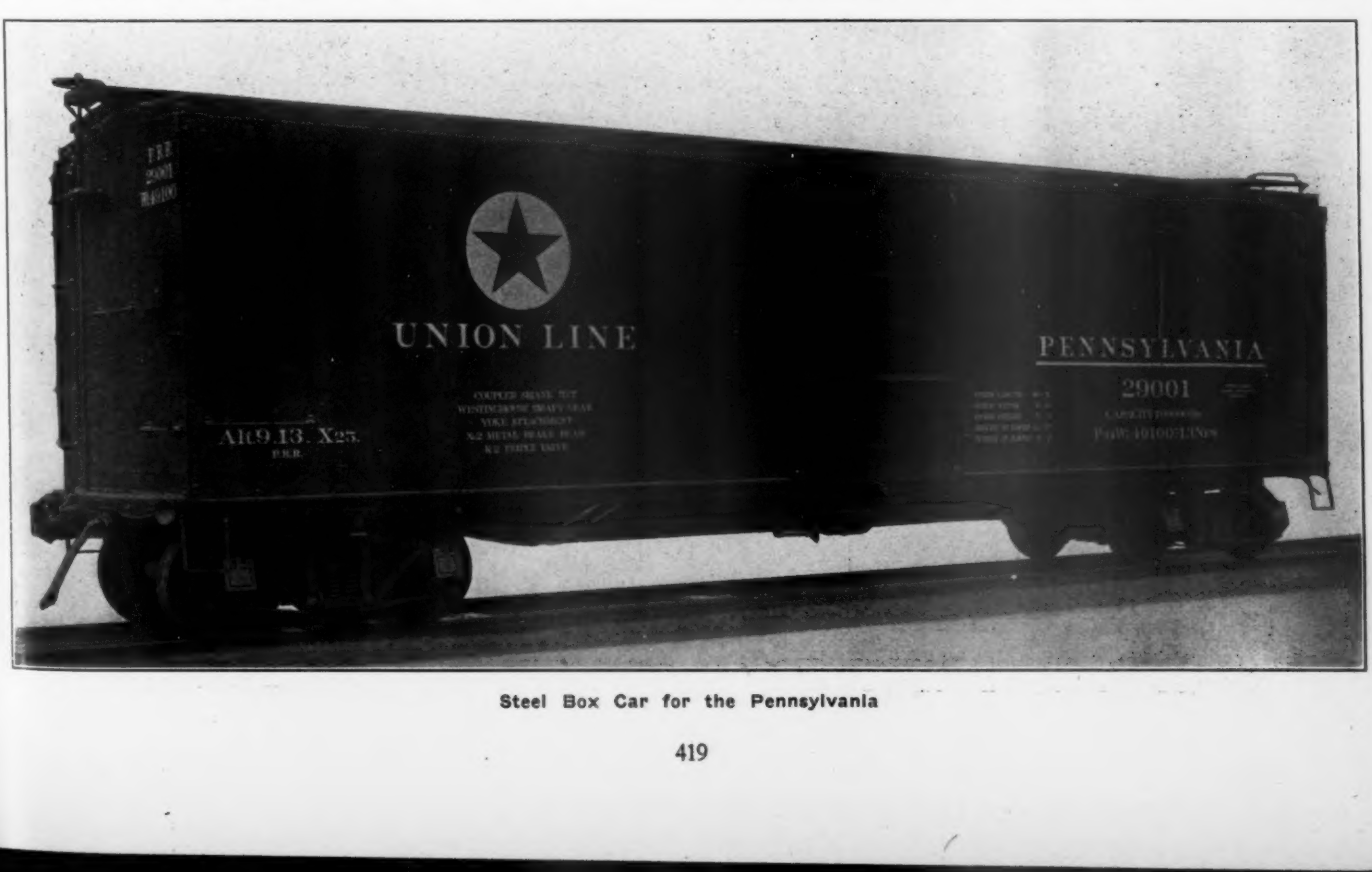
UNDERFRAME

The underframe is of the type in which the weight of the superstructure and lading is transferred to the center sills by means of two crossbearers or cantilevers and the end sills. The

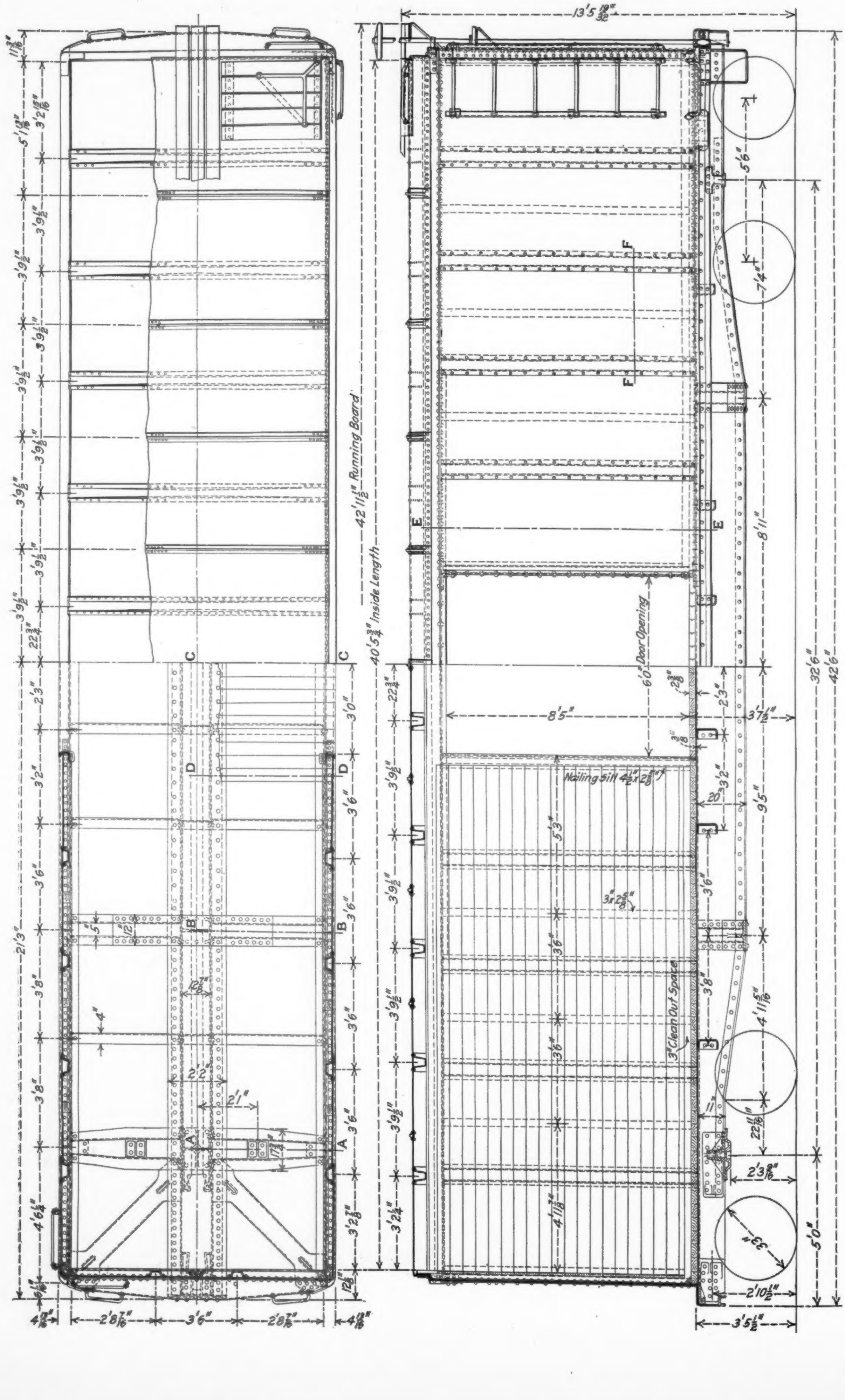


Arrangement of the Underframe and Details

center girder has a minimum section area between the rear follower stops of 34 sq. in. and is built up of two 3/8 in. fish belly type pressed U or channel shaped sections, 20 in. deep between the crossbearers and with 4 in. flanges top and bottom, the channels being spaced 12 7/8 in. back to back and tapering to 11 in. at a point 22 11/16 in. back of the center plate. There is a 3/8 in. by 26 in. top cover plate riveted the full length of the center sills,

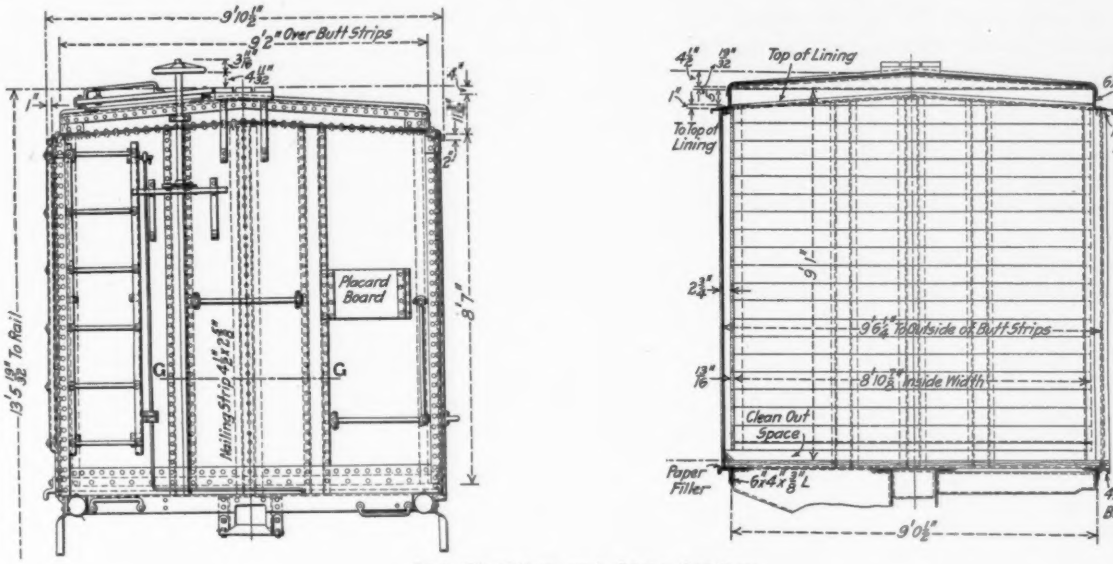


Steel Box Car for the Pennsylvania



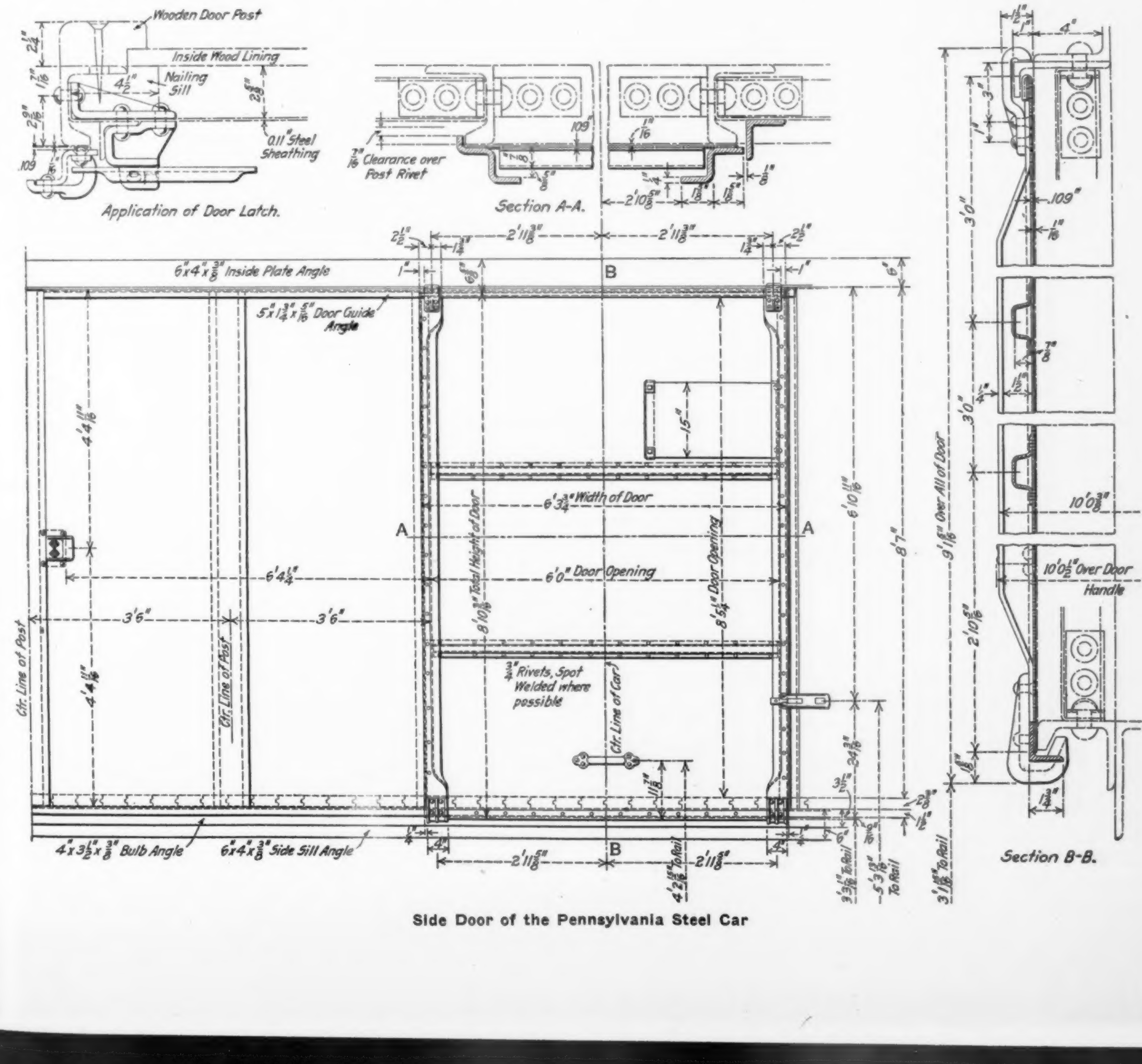
General Arrangement of the Pennsylvania Steel Box Car

and a 4 in. by 4 in. by 9/16 in. angle riveted to the bottom of each sill on the inside and extending between the back draft lugs, which are incorporated in the center plate reinforcing casting. steel spreader at each point of connection between the cross-bearers and the center sills, and pressed spreaders between all intermediate diaphragms. The crossbearers are composed of



End Elevation and Cross Sections

The center construction is also reinforced at each end by a cast steel striking plate and front draft lugs combined, and there are also a cast steel forcing casting above the center plate, a cast two dished diaphragms, 3/8 in. thick and having $3\frac{1}{2}$ in. flanges. These are set 5 in. apart and have 12 in. by 3/8 in. top and bottom cover plates extending across the center sills and riveted to

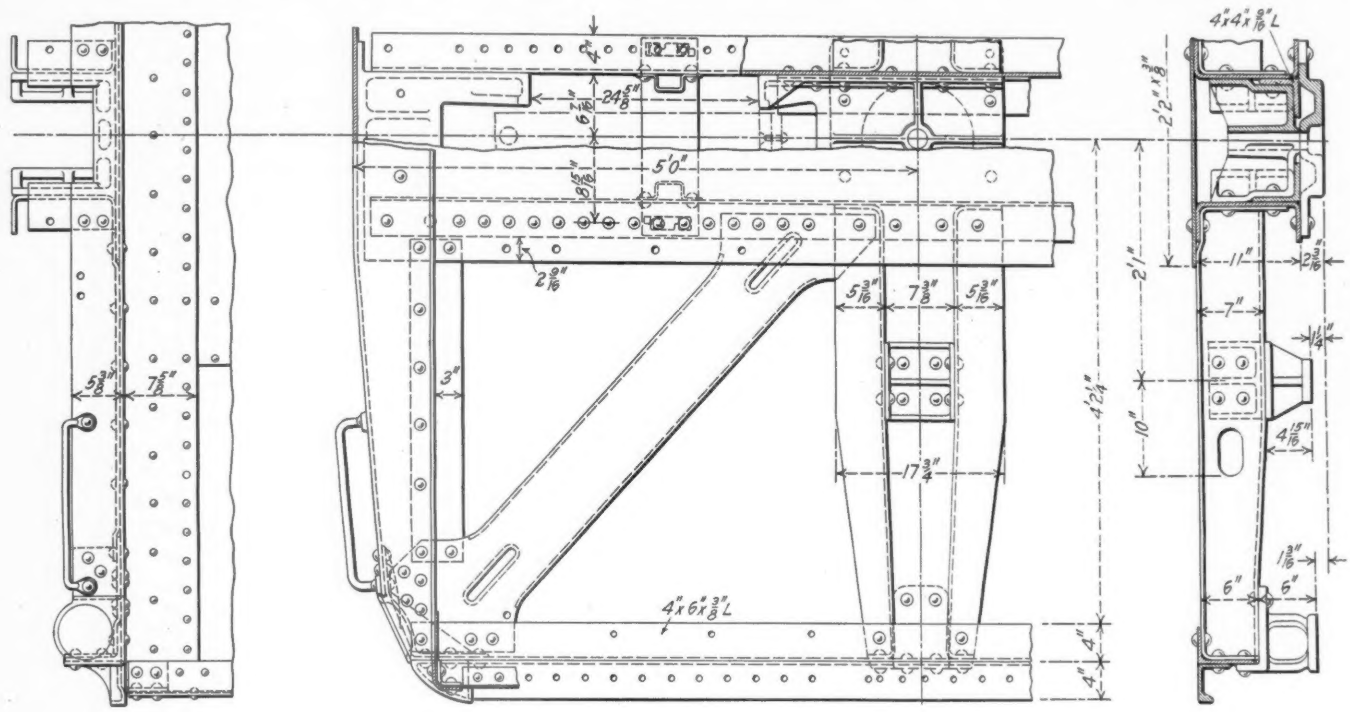


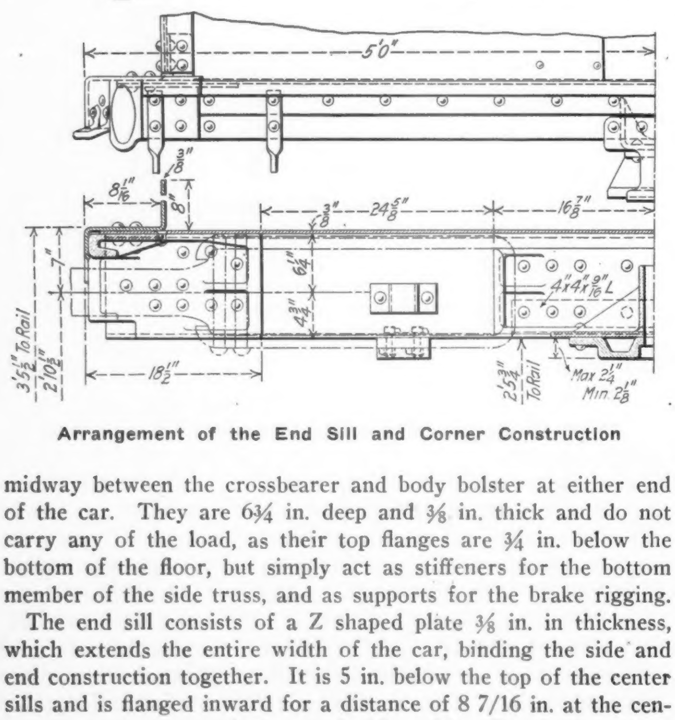
Side Door of the Pennsylvania Steel Car

the crossbearer flanges. The crossbearers are riveted to the center sill and the bottom member of the side truss.

The body bolster is composed of a diaphragm 3/8 in. thick, 7 in. deep, 7 3/8 in. between vertical walls and riveted to the center sills and side truss. This member has to take care of the side bearing thrust only and does not carry any of the load. Above the side bearing, which is a steel casting, is a cast steel reinforcing block, and at the extreme end is a combined roping iron and jacking casting. The drop forged center plate is secured to the flanges of the center sills, as well as the center plate reinforcing casting, which extends back towards the center of the car 9 in. from the center line of the center plate, and reinforces the center sills.

There are six intermediate diaphragms on either side of the car, four of which are located between the crossbearers and one





Arrangement of the End Sill and Corner Construction

midway between the crossbearer and body bolster at either end of the car. They are 6 3/4 in. deep and 3/8 in. thick and do not carry any of the load, as their top flanges are 3/4 in. below the bottom of the floor, but simply act as stiffeners for the bottom member of the side truss, and as supports for the brake rigging.

The end sill consists of a Z shaped plate 3/8 in. in thickness, which extends the entire width of the car, binding the side and end construction together. It is 5 in. below the top of the center sills and is flanged inward for a distance of 8 7/16 in. at the center, narrowing somewhat toward either side. The back vertical leg, which is 8 in. high, forms a connection for the end construction. The end sill is secured to the striking plate and at either end to a cast steel push-pole pocket and corner casting, which are in turn riveted together and secured to the bottom member of the side truss and to the diagonal brace, while the top vertical leg of the end sill is riveted to the end sheets the entire width of the car.

The diagonal braces are of U shaped section, 8 in. wide and 3/8 in. thick, with 2 1/2 in. flanges pointing downward. They are flattened at both ends, being fastened to the top flange of the center sills at one end and to the push-pole pocket and the bottom member of the side truss at the other end.

The side sill, or bottom member of the side truss, runs continuously between the end sills and is composed of a 4 in. by 6 in. by 3/8 in. angle and a 4 in. by 3 1/2 in. by 3/8 in. bulb angle, which are riveted together back to back. The short leg of the angle points towards the center of the car and the long leg of the bulb points outward, both legs being in the same horizontal plane as the center sill cover plate.

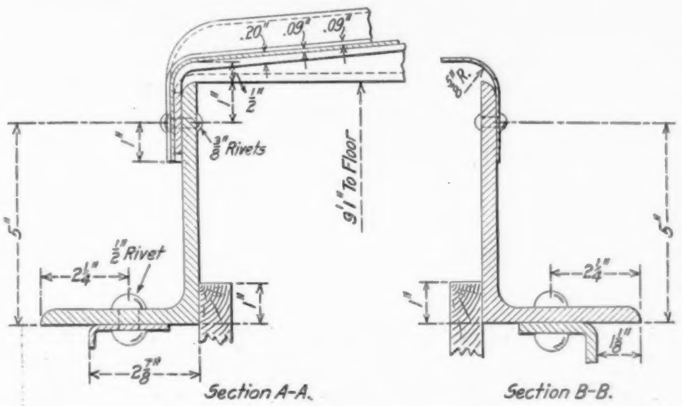
SUPERSTRUCTURE

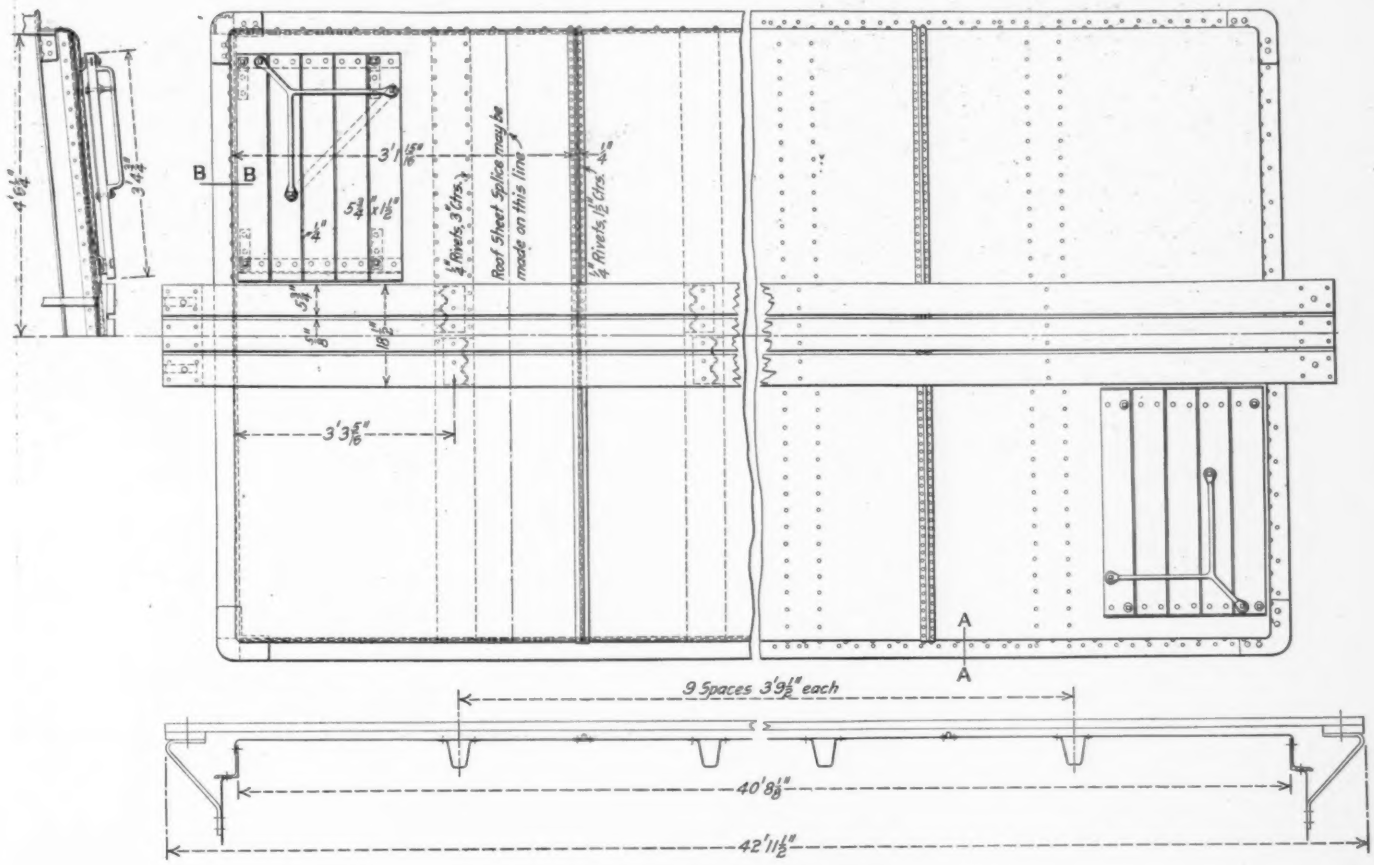
In designing this car efforts were made to provide as great a protection as possible for the lading in case of accident or rough usage, and to reduce, as far as possible, the number of parts. The superstructure was designed with an outside shell composed of a series of 1/8 in. sheets for the side, and 1/4 in. sheets for the ends, in which the posts are pressed integral. A U shaped post is pressed into one end of each sheet and is overlapped by the adjacent sheet, which acts as a cover plate for the post and gives a smooth surface on the outside of the car. The post portion of the sheet is 2 3/4 in. deep and 4 in. wide at the back. The sides of the car are composed of ten sheets each, which have a 2 in. flange, top and bottom, by means of which they are secured to the bulb angle of the side sill and to the 6 in. by 4 in. by 3/8 in. eave angle or side plate at the top.

The end construction is similar to that of the sides, each end being composed of three sheets, the two nearest the sides of the car containing the depression which forms the post. Where the central sheet overlaps these, they are depressed 1/4 in., making the outside face perfectly smooth so that it may fit down snugly behind the end sill. The middle sheet has an additional U shape stiffener at the center, 2 5/8 in. deep, 9 1/2 in. wide and 1/4 in. thick, extending vertically from the end sill to the eave angle. The side

door posts are made up of 4 in. by 3½ in. by ⅜ in. bulb angles.

The side and end sheets are tied together by a cover plate, L-shape in section and ¼ in. thick. This is capped top and bottom by suitable castings, which finish off the corners, and at the same time act as a connection between the side and eave angles and the side and end sills. To the side and end sheets, midway between the posts, vertical nailing strips are secured, to which the lining is nailed in a horizontal position.





Arrangement and Details of the Roof

The carlines are of the bathtub or U type, being spaced 3 ft. 9½ in. apart, resting on the 6 in. vertical leg of the side eave angle and extending downward from the side a sufficient distance to be securely riveted. The 3/32 in. steel roof sheets are continuous across the car, being spot welded to the carlines, which are located in their center. This allows the butt joint to come midway between the carlines, with the exception of the end roof sheets, which, because of the position of the last carline, must cover one and one-half spaces.

The roof sheets are flanged down on the vertical leg of the side and end eave angles 2½ in. and are secured to them by ⅜ in. rivets spaced 4¾ in. apart. Between the roof sheets and the eave angles are 3/16 in. washers, through which the rivets are driven. This construction allows for a slight ventilation and yet is small enough to keep out anything which might cause damage to the lading. The roof sheets are fastened together by an outside and inside strip, the outside strip being 2½ in. wide and 3/32 in. thick and pressed up in the center ⅞ in., which adds to the stiffness of the structure. The inside strip is 2½ in. wide and 3/16 in. thick. These strips are continuous across the car and are riveted to the roof sheets with ¼ in. rivets spaced 1½ in. apart. To insure a perfectly water-tight joint, tar paper is placed between the outside butt strip and the roof sheets. The end and side eave construction is the same, except that there is no ventilation at the end.

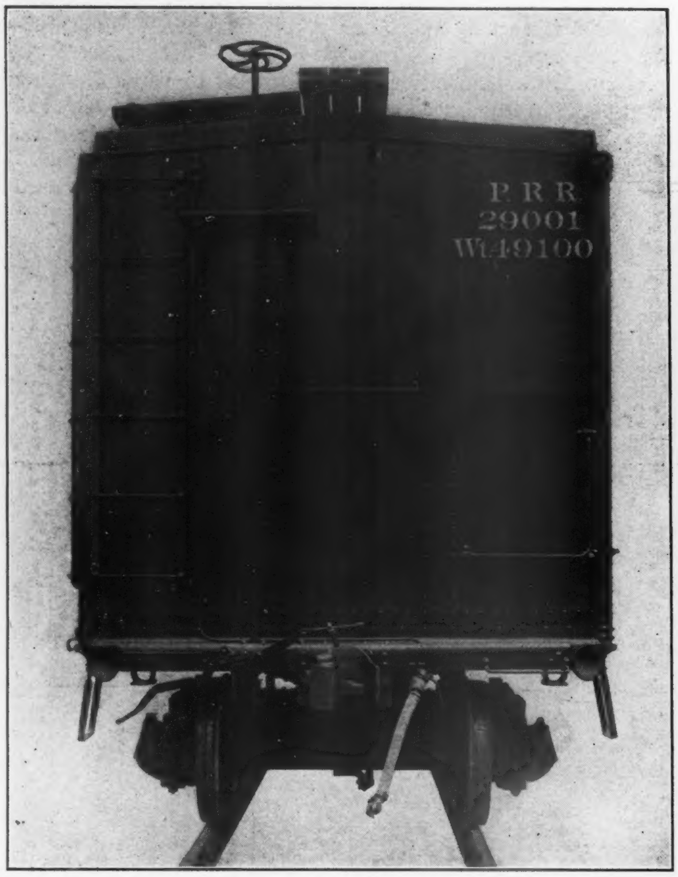
The 13/16 in. pine inside lining is nailed to vertical nailing strips, conveniently spaced around the sides and ends. The lining extends to within 3 in. of the floor. There is an air space back of the lining which allows for ventilation, and also facilitates cleaning. The application of a triangular grain strip around the edge of the floor, next to the side sheets, allows all foreign matter to work its way out from behind the lining.

A new feature in this car is the manner in which the safety appliances are secured. All grab irons are fastened to castings by means of a slotted hole in the face, which permits the removal of the grab iron bolt, and thus the renewal of the grab irons without disturbing the inside lining. A like provision is made for the side door stop.

DOORS

The car is equipped with outside hung doors, supported at the top by hangers at both corners. A 5 in. by 1¾ in. by 5/16 in. angle acts as a top guide rail and weather strip, the short leg being turned down over the face of the door. The door is made of .109 open hearth steel, with two vertical Z-shaped edge stiffeners, which are flattened out, top and bottom, supporting the door hanger and door guide castings. The rear stiffener laps

over the door post, and the front one butts against a 2 in. by 2 in. by ¼ in. angle riveted to the side sheets and projecting slightly beyond the door, thus forming a weather strip, front and back. There are two horizontal U-shaped sections pressed in the end of the top and intermediate door sheets, which overlap the adjacent sheets, forming a stiffener across the door. At the bottom of the door is a 1¾ in. by 1¾ in. by ¼ in. stiffening angle, which runs continuously between the vertical stiffeners. The inside of the door is perfectly smooth, all rivets being countersunk. A clearance of 1/16 in. is allowed for the door to clear



End View of the Pennsylvania Steel Box Car

the door post. The floor is extended through the door opening, flush with the door post, and is supported by the bulb angle of the side sill.

The following are the leading dimensions and data:

Length over end sills	42 ft. 6 in.
Inside length	40 ft. 5 in.
Inside width	8 ft. 10 in.
Inside height	9 ft. 1 in.
Height top of rail to top of floor	3 ft. 7½ in.
Height at eaves	12 ft. 10 in.
Width at eaves	9 ft. 2 in.
Capacity	100,000 lb.
Cubical capacity	2,343 cu. ft.
Weight	49,100 lb.

Peat in Russia.—Some further efforts are about to be made to develop the peat resources of Russia. The state is very largely interested in the subject, as it owns large areas of peat land, the full resources of which are but imperfectly known.—*The Engineer.*

Electrification in Germany.—The trials of multiple-unit trains on the Laudan-Konigszelt mountain railways in Silesia, Germany, have proved very satisfactory, and the service is to be extended to Fellshammer, and shortly to the Austrian frontier, at Halbstadt, a total distance of 21.7 miles. The full electrical service will be put into operation before the end of the year, and the working of through trains by locomotives will commence during the summer.—*The Engineer.*

TOOL CABINET FOR THE MACHINE SHOP

BY C. E. PADDOCK

The photograph shows a tool cabinet used in the Springfield, Mo., shops of the St. Louis & San Francisco. It is designed for use with large machines requiring many tools, such as boring mills and planers. The top consists of four shelves made of No. 16 iron, the back of each shelf being bent up ¾ in. to prevent tools from being pushed through, while ½ in. of the front is turned downward, thus increasing the rigidity of the shelf. A variation of width between shelves is made to allow for different size tools. The light through these spaces makes the selection of tools easy and simplifies the blowing out of dust. Between the lower shelf and the top of the cabinet is a 6 in. space, which is deep enough to make the entire top of the cabinet available as a table. The drawer is for operator's small personal tools and

Steel Tool Cabinet for Use with Boring Mill

the spaces beneath and to the right may be used for larger tools, blue prints, etc. The door which closes this part of the cabinet swings downward and forms a resting place for set calipers and working drawings. The lower half of the cabinet may be used for clamps, bolts and blocks. Underneath is room for mandrels and various other tools not in constant use. On the right hand end is a shelf for holding small boring bars, sockets and the table center. On the left hand end of the cabinet are hangers which hold a set of wrenches, and hardened gages for all classes of work done on the machine, which are kept at every one's service and are never locked up.

For small machines a narrower cabinet is used which is simply provided with a small drawer and is without shelves or the door in front. Such machines as wheel lathes and planers use the larger type of cabinet without the top shelving. For use with drill presses the smaller cabinet is built with conveniently arranged shelving for holding drills, which the operator may keep locked up.

TOOL FOREMEN'S ASSOCIATION

Reports on the Standardizing of Reamers, Special Tools, Grinding, Dies, and Tool Distribution

The sixth annual convention of the American Railway Tool Foremen's Association was held at the Hotel Sherman, Chicago, July 20-22, inclusive. The meeting was called to order by A. M. Roberts of the Bessemer & Lake Erie, president of the association. After a prayer by the Rev. Howard A. Lepper, rector of Christ Church, Englewood, the association was welcomed by J. F. De Voy, assistant superintendent motive power and machinery, Chicago, Milwaukee & St. Paul. Mr. De Voy spoke very highly of the work done by mechanical department associations, stating that the members in attendance at the Atlantic City conventions this year seemed to pay more official attention to what the junior organizations were doing. Many of the superintendents of motive power in attendance when questioned stated that the time had come when the older associations were becoming more dependent on the junior associations for help in developing the mechanical departments of railways. Money spent by the railroads in sending men to conventions of this kind is not wasted in the least, and if the members will give up their ideas to their fellow workers the railroads will be greatly benefited.

Mr. De Voy paid special tribute to the integrity and sincerity of purpose of the men in the motive power department. Conventions of this sort will do a great deal to promote the general efficiency of that department. He referred to the tool foremen as efficiency engineers of the highest type and pointed out that their special field lay in establishing standards that would facilitate the work and reduce the cost of production, referring to the work done in the automobile industry as an example.

A special field for the tool foremen is the devising of safety appliances to be placed on machines. By their ingenuity they can devise efficient and inexpensive safeguards that will be of vast benefit to the railroads they serve. He called on the tool foremen to shoulder part of the responsibility the state and federal laws have placed on the railroads and do all they can to perfect the safety appliances. Mr. De Voy closed his remarks with some very encouraging words as to the business conditions. Within the past month the Milwaukee has increased its force ten per cent. He laid particular stress on the benefits the railroads would derive from the abundance of grain that is being shipped.

PRESIDENT'S ADDRESS

President Roberts spoke of the opportunities the tool foremen have in increasing the efficiency of the mechanical department. The higher officers are looking to the tool foremen more and more each year, calling on their ingenuity and skill to increase the output of the shops and at the same time improve the quality of the work. A special field for the tool foremen is to standardize the tools so that a much less number will be required to perform the necessary work. Mr. Roberts also spoke of the benefit he has personally received by attending the conventions. Many new ideas obtained from other members through the discussions on the floor have been successfully applied by him.

STANDARDIZING REAMERS

C. A. Shaffer, Illinois Central: To any one who has had practical experience in a locomotive repair shop the economy resulting from standardized reamers for the work is obvious, and to those who have gone into the matter systematically no argument is necessary to show wherein the saving may be effected. If conditions would not permit of going into the matter in a general way, possibly on account of not wishing to replace all of the large stock of tools of various descriptions at one time, it may be possible to select one or more sets of reamers to start. A saving in time of from one to eight or ten hours may be effected on jobs when compared with the old practice of putting the work into a machine and boring it for a fit. Then, too, the life of the job will be much greater if it is done with the proper tools.

A conservative check on the average time being consumed on several operations on a certain job on a large railroad was as follows: Bolting crossheads to face plate on a lathe and reboring for pin or rod fit, 3 hr. 15 min. to 3 hr. 40 min., as against 20 min. by using a standard reamer. Clamping rod on horizontal boring mill or drill press and truing up knuckle pin hole with a boring bar and cutter, 2 hr. against 15 min. with the reamer. Clamping steam or dry pipe to horizontal boring mill, and truing up joint with bar and cutters, 2 hr. 45 min. against 30 min. with the standard ball joint reamer, which could make the fit with the standard radius.

These are only the initial time-savings, and much more will be realized when it comes to assembling the parts as they may be put together with greater ease and speed. Before making drawings for standard tools one should carefully study their requirements for limitation and dimensions for the various kinds of locomotives handled, and, if possible, anticipating possible new power which the roads may acquire. The commercially manufactured locomotive tapered reamers, which are cataloged by all the leading small tool manufacturers, for use on rods and frame work, come far from being a suitable arrangement for use on the heavy power of today. A revision in standards along this line would, no doubt, result in increased business for the manufacturer and economy for the roads who buy the greater proportion of such tools instead of making them themselves. One of the main advantages in the use of standard reamers is that it admits of greater interchangeability and carrying in stock finished or rough turned parts for immediate application, thereby saving considerable material and a great deal of time in doing the job as well as getting the engine back into service quickly.

E. J. McKernan, Atchison, Topeka & Santa Fe: On the Santa Fe lines all the frame reamers for locomotives have 1/16 in. taper in 12, and I carry the sizes from 1¼ in. in diameter, advancing by thirty-seconds of an inch to 2 in. in diameter. All sizes of reamers one inch in diameter and under are purchased from the manufacturer, and all those over are made in the tool room at Topeka. The lengths of the reamers vary from 5⅝ in. up to and including 17½ in. There is also a set of reamers 28½ in. long ranging from 1⅛ in. in diameter to 2 in.; they are used in frame work. Nine reamers have been adopted as standard for the crosshead and piston work. These reamers are tapered ½ in. in 12 in., and are made with a left hand spiral. Four reamers are used for the knuckle pin work on side rods. They have a 9-in. flute and a 1½-in. taper in 12, with a left hand spiral of 68.57 pitch. For our link blade pins we have a standard tapered reamer with a straight flute 12 in. long. This reamer is tapered ¾ in. in 12 in., and is 1¼ in. at the small end. This one reamer takes care of all the jaws on our Stephenson gears. The standard reamers for saddle flange work are used in all work on cylinder splices, as well as on the flanges for truing up the holes after the cylinder has been bolted. These reamers are 6 in. over all, and have a square shank. They are tapered to 1/16 in. in 12 in. For general motion work two reamers are used, one 17½ in. and the other 19½ in. over all. They have a taper of ½ in. in 10 in., for the Walschaert valve gear, and a taper of 3 in. in 12 in. for the Stephenson gear. They measure 1¼ in. on the point, and have a left hand spiral of 68.57 pitch.

J. P. Mauger, Philadelphia & Reading, presented blue prints

of the regular line of taper reamers for general repair work. These reamers are made with a straight, heavy pitch flute, with a variation of the pitch from nothing to .016 in. from cutting edge to cutting edge; that is, in milling the flutes .016 in. is gained on the first half of the diameter, and dropped off until it is back to zero. Very little difference was found in the life of the straight and spiral fluted reamers; the straight fluted reamers do the work nicely, and are much cheaper to make.

DISCUSSION

A. Meitz, Missouri, Kansas & Texas: In using the rod reamer, I prefer a square shank instead of a taper. We found out that when the reamer closed solid we made the hole a little bit larger on the outside and also on the bottom. If you have a square socket the reamer will make a perfect hole. I make a straight blade reamer and protect the edges by running a left-hand square thread about two to the inch. This protects the cutting edge on the blade as well as keeps the reamer from hugging in. I make these reamers cheaper than milling a spiral flute.

C. A. Shaffer: On some reamers that we made with the square sockets, we left a collar about one-half inch long above the square and put a groove in that collar with two set screws in from each side of the square socket with a ball joint, and we have to bring these set screws into the groove a little bit. It will hold the reamer in the square socket and lift the reamer out.

J. J. Sheehan: Mr. Meitz raised a timely point about the taper fit of the spindle. If the hole isn't true it is liable to force the reamer out. We had that experience and we got around it by making a knuckle socket fitting in a sleeve with a Morse taper fit. That would allow the knuckle to move in either direction. There is just enough movement there to allow the reamer to act freely in the hole, and we have not experienced any trouble. If there was a standard taper for all that work it would simplify the arrangement very much. I think that for all locomotive bolt work the 1/16 taper in 12 is the universal standard.

H. Otto: We cut frame reamers any length and leave 1/32 in. to be milled off. We have a triple head lathe so that we can ream three at a time. We do not have an electric furnace but we temper them in a bath. We heat the steel and harden, then we draw the temper in an oil heated bath. We clamp our reamers to prevent warping, and do not lose more than 2 per cent. An inch reamer 7½ in. long costs shop made $3.82; a 2 in. reamer 7½ in. long costs $6.55; a 28½ in. long reamer (I am not much stuck on the long reamers) 15/32 in. in diameter costs $4.38, and a 1 5/6 in. reamer costs $6.29.

B. Henrikson: Our reamers have a taper of 1/16 in. per foot. Our large reamers are inserted high speed steel and our small reamers are all high speed steel. We are notching our reamers. I understand that the spiral reamer is better than the notched, but there is more trouble in making them.

Secretary Davis: Do you have any trouble with the high speed reamers being brittle or breaking? Do they break many of them from side strains?

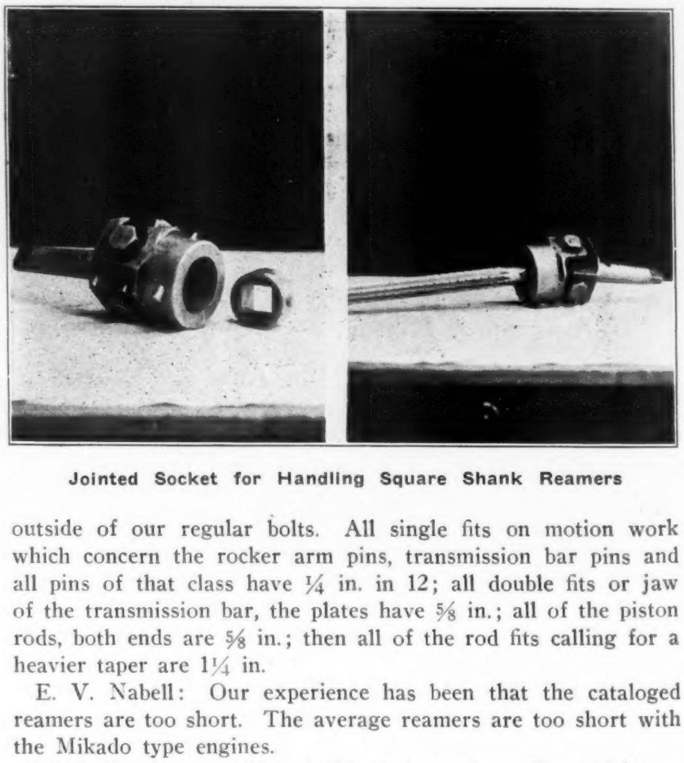
Mr. Henrikson: Yes, they do, but I find that is due to the temper.

O. W. Kinzie: I prefer the spiral reamer over the straight reamer, and I am positive that the spiral reamer is much more efficient. We are putting in less teeth and we get good results. In the year's time that we have had this set of frame reamers and rod reamers in use, I do not believe I have found one broken out of the full set. We make our reamers mostly 1/16 in. taper in 12 in. We use carbon steel altogether for these reamers and we have never had any trouble about the motors being too fast for the reamer, especially the heavy reamer. For bridge reamers, such as the boilermakers use, we have to use high speed steel. The machine work on the spiral reamer is practically the same. We mill our spiral reamers with a triple head device. I admit there is more trouble in keeping the spiral reamer straight, for the reason that you cannot clamp them, but we have not had any trouble to complain of. I think the advantages of the spiral reamers are so greatly superior to the straight reamers that it pays in the end to make the spiral reamer. We harden in the electric furnace. The spiral of the reamers would be about ¼ of a turn, the length of the reamer.

W. C. Stephenson: On the Atlantic Coast Line we tested nine reamers up to 1½ in. We had nine high speed and nine carbon, and we milled them with 5 flute and 8 deg. We milled some 5 flutes and 12 deg., and we found that the one with 8 deg. gave better results. We turned them down from the little end for 1 in. with a 1¾ in. taper; the other part of the taper is 1/16 in. to the foot and we milled them spiral left hand. We use carbon steel and get very near the results on the carbon that we do on the high speed, but I believe in high speed reamers provided you get the right degree spiral and get them tempered right. If you get the right spiral on them they won't feed too fast. We do most of our work with large reamers by hand.

E. H. Whittier: All our reamers we make with a square shank. We are using air motors, or a drill press. The photograph shows the joint socket. There is oscillation enough in the socket. We have a set of little collars that have the square shanks. I find they give perfect satisfaction.

A. R. Davis: We have adopted three tapers to cover all work



Jointed Socket for Handling Square Shank Reamers

outside of our regular bolts. All single fits on motion work which concern the rocker arm pins, transmission bar pins and all pins of that class have ¼ in. in 12; all double fits or jaw of the transmission bar, the plates have ⅝ in.; all of the piston rods, both ends are ⅝ in.; then all of the rod fits calling for a heavier taper are 1¼ in.

E. V. Nabell: Our experience has been that the cataloged reamers are too short. The average reamers are too short with the Mikado type engines.

W. C. Stephenson: Everybody carries reamers from ¼ in. up for odd jobs: I grind 1/32 in. off each time it is necessary to grind a reamer and mill the flute so that I can grind it about 4 times; then we have to mill it. When high speed reamers give out we turn them down. We do not scrap any high speed at all. We reclaim everything.

G. W. Smith: We have reamers 12 in., 17 in. and 27 in. long, and that covers the ground pretty thoroughly, especially the heavier power that has been introduced of late years which require the long reamers 27 in. I never have any trouble in regard to reaming as long as we use these sockets on the square shanks. It doesn't make any difference how long the hole is on any drill press or any air motor; it can adjust itself.

President Roberts: We have recently adopted the 1/16 taper for all frame bolts, smoke arch bolts, rod bolts, stretcher pins and all truck bolts. In the reach rods we use 1¼ in. taper; in angle pins 1½ in. taper; ½ in. crosshead pins and ½ in. in piston fits.

All of those reamers are square-headed. For the frame reamers where we use air motors we simply have a short square shank about 2½ in. long. The end of that shank fits the motor and the other end where the reamer fits in is made of various sizes. I find that the regular commercial reamers are almost invariably too short. We use quite a number of reamers 26 in. long of various sizes, and we use lots of 16 in. reamers. We have also the 14 in. reamer, while the commercial reamer comes to about 10 in. We buy all high speed steel reamers. We have lots of trouble with the carbon reamers in regard to durability.

[The secretary was instructed to obtain from the members of the association their requirements for reamers with a view of adopting standard reamers at the next convention.]

TOOL ROOM GRINDING

W. C. Diebert, Chesapeake & Ohio: A great deal of difficulty is experienced in grinding tools where there are no automatic machines. Among the special tools for grinding made at Clifton Forge, Va., are a surface grinder, an automatic reamer grinder, a small die grinder and a grinder for cutting the cutters for the Ingersoll milling machine. This latter grinder will cut up to 14 in. in diameter, and grind the radius on the cutters for those used in channeling out driving rods. The wheel lathe tools are given an angle clearance of 7 deg. and a 10-in. by 1½-in. hard wheel is used for grinding them. By using a templet on them from time to time a very good job may be obtained. All the special taps that must be backed out are given about 2 deg. clearance, while those that are driven all the way through are given a little more.

The bolt cutter dies are ground to an angle of 25 deg., and a wheel one-eighth larger than the bolt is used to grind the clearance. It has been found that the throat of the Lassiter staybolt machine dies must be made just right as otherwise the head would not be heavy enough to start them. An angle of 25 deg. has worked very well.

J. C. Bevelle, El Paso & Southwestern: The tools that are issued from the tool room on check are all ground in the tool room. The two cutting edges of drills should be at an angle of 59 deg. for ordinary purposes. The angle of lip clearance should be about 12 deg. This angle, however, should gradually increase as the center of the drill is approached until the line across the center of the web stands at an angle with the cutting edges of 135 deg. For a heavy cut in soft material the angle of lip clearance may be increased to 15 deg. The failure to give sufficient angle of lip clearance at the center of the drill is the principal cause of splitting drills up the web. We use a No. 30 grain wheel with very satisfactory results.

Standard reamers should be kept properly ground and sharp, as otherwise a great deal of time will be consumed or wasted by the man who is using them. In the shop at El Paso, Tex., the reamers are not placed in the rack until they have been inspected and put in first class condition. The bolt or frame reamers used in that shop are ground with as large a wheel as possible, so that they will not be hollow-ground. The clearance of the reamers and such tools is determined by the use of an external cylindrical gage the corresponding size of the reamer. A reamer's proper clearance is 3 deg.; any more will allow it to chatter and ream the hole out of round and dull it quickly. All taps are ground on the face of the flute just enough to renew the edge of the teeth, and precaution must be taken in keeping the face of the flute in line with the center of the tap. The points of the taps are ground with a relief of about 3 deg. In grinding milling cutters the teeth are sharpened on a cutter grinder, using the finger of the machine as a means for obtaining the proper clearance, which is about 3 deg. Formed milling cutters are always ground on the face so as to retain their shape, and care should be taken in keeping a formed cutter, more especially a gear cutter, sharp at all times. Peg milling cutters are ground in the same manner. A groove is milled between each row of the cutters about 3/16 in. wide and 1/16 in. deep, so that the finger may serve as a guide. Disc flue cutter used for grinding off boiler flues are also ground to renew their cutting edge.

Standard bolt dies that are used in bolt-threading machines are ground at the throat with a wheel about ¼ in. larger than the bolt which they are to cut. The heavy roughing tools that are used on wheel lathes for turning tires are ground to the following angles: Clearance angle, 6 deg.; back slope, 8 deg.; side slope, 14 deg. This allows a very fast speed. The finishing tools used for tire turning have a clearance of 6 deg., with a back slope of 8 deg.

Owen D. Kinsey, Burnside shops, Illinois Central: Our grinding machinery is placed as far away from precision machinery as possible to avoid trouble from dust, and in a position to command good light and ventilation. The spindles of all the grinding machines have been made standard so that the grinding wheels may be interchanged. Instructions have been posted on each machine showing the belt position for wheels of different diameters. Success or failure in grinding operations depends directly on the proper selection of wheels for the particular work in hand. We have found that a cool, free cutting wheel is the most economical in the long run even though the wheel life is shorter. The heaviest cutters we handle at present are 10 in. by 20 in. peg cutters. These cutters are ground on a Bath Universal grinder using a radius arm projecting from an arbor upon which the cover is mounted. This arm travels on a fixture mounted on the side of the machine, and produces a helical curve permitting the grinding of the cutting faces of the peg. The cutter is then revolved, and the teeth are ground to an even length, after which the clearance angle is ground.

Thomas F. Eaton, Baltimore & Ohio: There are 70 wheels in service at the Baltimore shops, and it has been found expedient to have one man inspect all the wheels throughout the plant rather than have each department look after their own. By this means I am kept posted as to the condition of the wheel, and we are enabled to keep the wheels in a safe and efficient running condition. For rough grinding wheels No. 24 grain wheels with a medium soft bond are used, and for the Universal tool grinders on finished tools a No. 60 grain wheel is used. An apprentice operates one Universal tool grinding machine, which handles plain reamers and shanks and tangs.

DISCUSSION

The principal point of discussion on this subject was the grinding of high speed steel. Many of the members reported poor success with grinding high speed steel wet, as it had been found that the steel would split and chip, due to uneven heating and cooling, and for that reason they have been grinding this grade of steel dry. It was pointed out, however, that the probable trouble was that when grinding wet care was not taken to see that the metal did not get overheated, whereas grinding dry more care would be taken. Some members found the spiral reamers so difficult to grind that they have not made many on that account. It was clearly brought out that with broken and dull tools good work could not be expected, and the moral effect on the workmen would be such as to make him discontented and greatly decrease his efficiency. Dull tools will also waste a great deal of power in machine tools. The grinding wheels should be kept in good condition, and should be made the job of one man, so it would be possible to hold him responsible for it. In grinding slab millers very good results will be obtained, not only from the life of the miller, but from the work performed, if the wire edge is taken off before it is given out to the workmen. Special care must be taken in using the right kind of abrasive wheel for grinding.

In the discussion the members digressed a little, and spoke of welding high speed steel to carbon steel bodies. Some members did not have very good success as the heat of the welding would draw the temper of the tool and not give good results. However, this has been overcome by brazing the shanks on

by the oxy-acetylene process. Electric welding was deemed to be more satisfactory, as it would localize the heat more, and thus would not heat up the tool as a whole too much. Instances were mentioned where high speed steel tips of about one inch material were welded on carbon steel bodies, both parts being heated to a definite temperature so as to prevent undue strain. These have given very good results, and were recommended by the members using them. One member reported that 27 to 30 pairs of wheels were turned with lathe tools thus made, at a speed of 28 ft. per minute. The high speed steel part of the tool weighed only about 8 oz.

SAFETY APPLIED TO GRINDING WHEELS

The following is from an address by R. G. Williams, safety engineer, Norton Company, Worcester, Mass.:

In view of the fact that grinding wheels are operated at such speeds that the cutting surface travels approximately a mile a minute, due precaution should be exercised to eliminate, as far as possible, all causes which are known to have been responsible for grinding wheel breakages, and to provide adequate means of protection for men and property if wheels are broken from any cause.

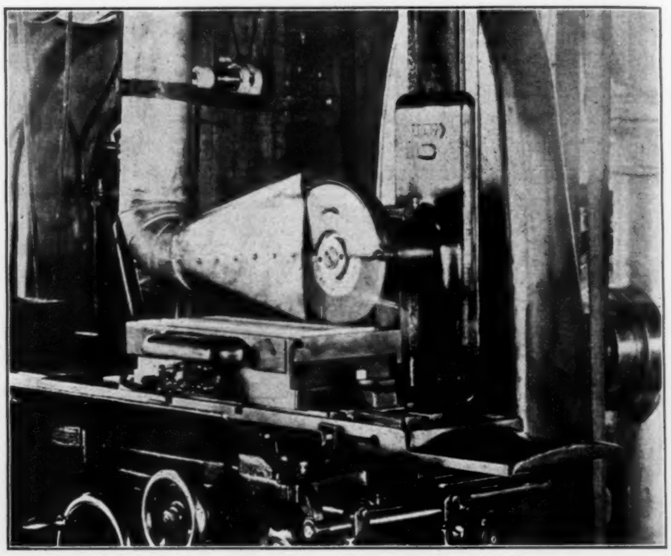
The manufacturers, immediately before packing grinding

Hood Protection for Wheel When Snagging Heavy Castings by Aid of Chain Hoist

wheels, submit them to a speed test in which the wheel is revolved at a speed which subjects it to between three and four times the centrifugal stress it will be subjected to under actual working conditions. Defective wheels break under this test. After completing a test, a record is made of the order number, etc., and each testing sheet is taken before a Justice of the Peace and the man doing the testing work is required to swear that he has made a true record of his work. The manufacturer thus has on file a sworn statement of every test made.

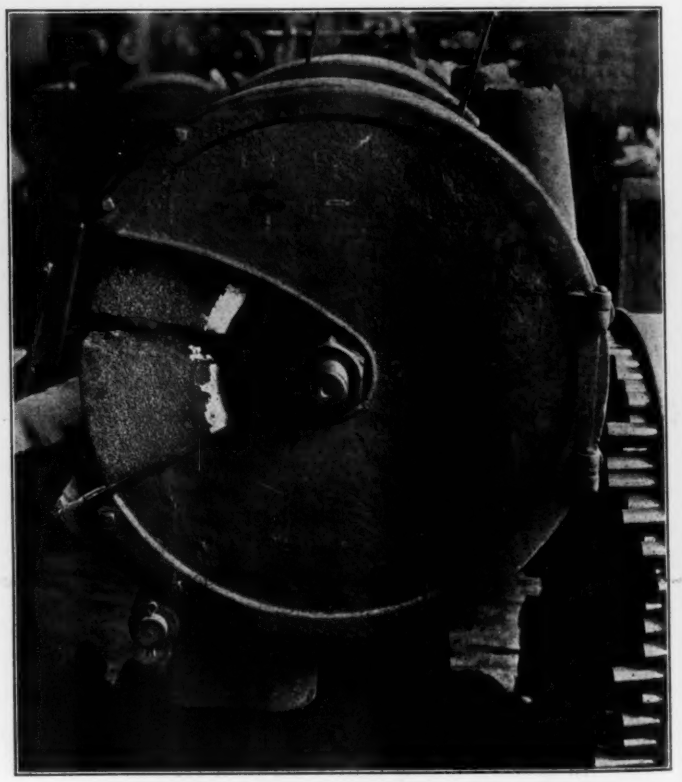
Instances are known where wheels have been sufficiently damaged, after they were tested and before being put to use, to weaken them to such an extent that breakage occurred when the wheels were run at ordinary operating speed. Defects which cause wheels to break thus easily can usually be discovered by tapping the wheel a light blow with a small hammer. If the wheel does not give out a clear ring, it should not be used, but the fact should be promptly reported to the manufacturer.

The design and the condition of grinding machines, as well as the foundation on which they rest, are very important and accidents can often be traced to a failure to realize the importance of one or more of these factors. Machines should be kept in good condition and should rest on a firm foundation. Machines used



Surface Grinder Connected with Dust System; Wheel Protected by Hood

for rough work, such as snagging castings, are subject to severe abuse and are seldom kept in good condition. Statistics show that a large majority of grinding wheel accidents occur in foundries, thus emphasizing the importance of the above points.

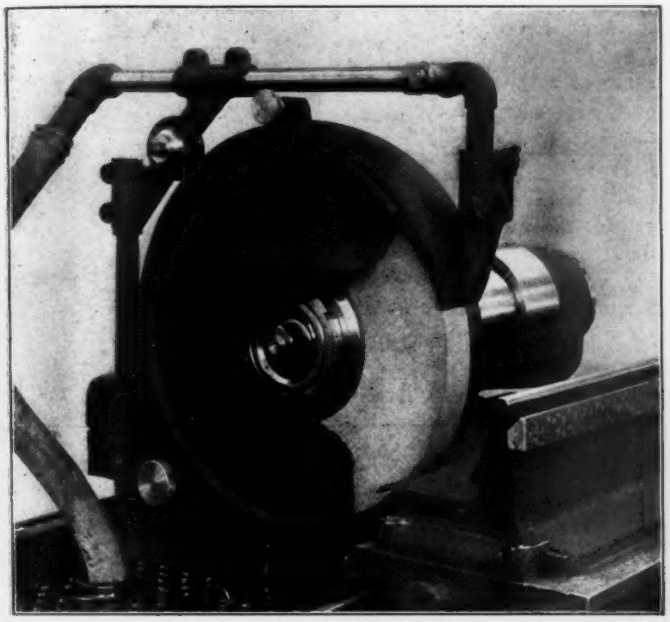


An Efficient Type of Hood for a Floor Stand

GRINDING WHEEL BREAKAGES

Grinding wheel breakages may be caused by the wheel receiving a blow on the side, by improper adjustment of the work rest, by the heating of the wheel from forcing of the work, by the careless handling of heavy work, by the mounting of the wheel

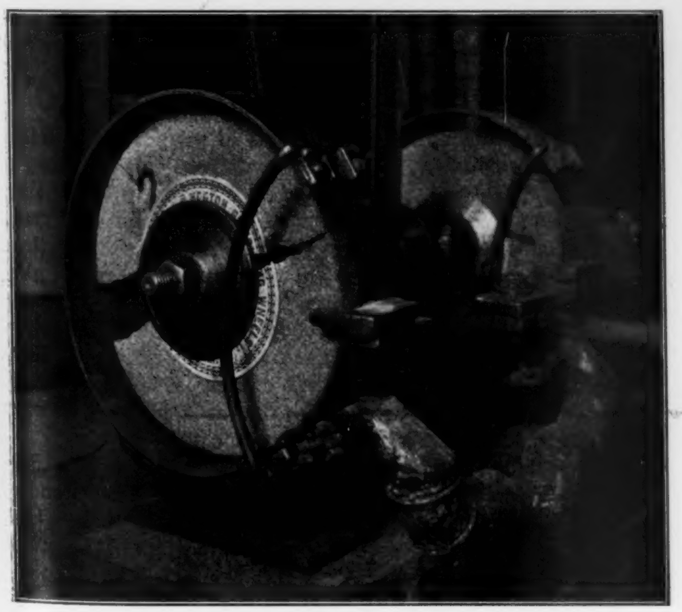
with flanges of unequal size, by uneven bearing of the flanges on the wheel, by the wheel running out of true, by the inside flange being loose on the spindle, by the hole in the wheel being too tight a fit on the spindle, by the use of straight instead of relieved flanges, by excessive tightening of the nut, by the use of washers that are too small or by none at all being used, by the overheating of the spindle, by the wheel running too fast or by mounting the



Hood on Norton Cylindrical Grinding Machine

wheel so that the nut works loose. Care should be taken to properly adjust machine parts so that there is not sufficient space between them and the wheel to allow the work to become caught. The work rest should be adjusted as closely as possible to the grinding wheel, as breakage may be caused from something dropping between the rest and the wheel.

Instances are known where breakage was the result of the



Wheel Broken from Excessive Heat Generated in Grinding

grinding surface of the wheel becoming very much heated. Usually the direct cause for such breakages is the fact that the wheel becomes glazed so that excessive pressure is necessary to keep up production. The remedy is to keep the wheel sharp or obtain a wheel better suited for the operation in question.

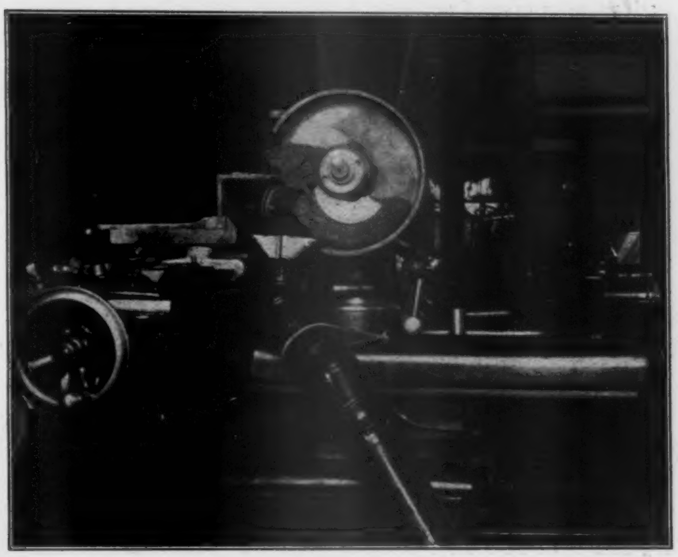
Serious accidents have happened where large castings are ground while suspended by means of a chain hoist and through carelessness the castings are allowed to strike against the wheel.

A cause of wheels running out of true is directly traceable to lack of proper attention to the machine bearings. The bearings become highly heated, the bearing metal flows, a heavy brake action is produced on the spindle and when the machine is stopped the momentum of the grinding wheel is sufficient to loosen the mounting. When the wheel is started again, the nut will not automatically tighten and the wheel will be running under dangerous conditions.

Wheels should not be allowed to remain partly submerged in water, because they will be badly out of balance when started. Some people seem to believe that water has a detrimental effect on grinding wheels. This is not true for the modern grinding wheels; even those bonded by means of silicate bonds, are made water-proof.

The inside flange should either be keyed or pressed on the spindle. Accidents have been known to result from the work being rubbed against a loose inside flange, thus exerting a brake action on the flange, which in turn causes the nut on the spindle to crawl, and in this way enough pressure is exerted on the wheel by the flanges to crush the structure of the wheel.

By the excessive tightening of the nut, sufficient pressure can be set up between the wheel and the flanges to crush the struc-



Cast Steel Protection Hood Adapted to Tool Cutter and Grinding Machine

ture of the wheel. It has been calculated that where the spindle is 1½ in. in diameter, a man with a 4 ft. wrench can exert a pressure between the wheel and the flanges of over a ton and a half.

Washers of blotting paper or some other compressible medium should be used between the wheels and the flanges. These tend to distribute the stresses set up when the flanges are tightened against the sides of the wheel. They should be somewhat larger than the flanges.

Polishing stands are sometimes used for rough snagging work with wheels which are much too heavy for this type of machine. Bench and floor types of grinding machines are usually designated by the size of the spindle where the wheel is mounted. It is therefore, common practice to designate the maximum size wheel to be used on any machine by tabulating spindle sizes and wheel sizes as follows:

Size of spindle	Diameter and thickness of wheel	Size of spindle	Diameter and thickness of wheel
¼ in.	4 in. x ½ in.	1¼ in.	14 in. x 2½ in.
½ in.	6 in. x ⅞ in.	1½ in.	16 in. x 3 in.
⅜ in.	7 in. x 1 in.	1¾ in.	20 in. x 3¼ in.
⅝ in.	8 in. x 1 in.	2 in.	24 in. x 4 in.
¾ in.	10 in. x 1½ in.	2¼ in.	26 in. x 4 in.
1 in.	12 in. x 2 in.	2½ in.	30 in. x 4 in.

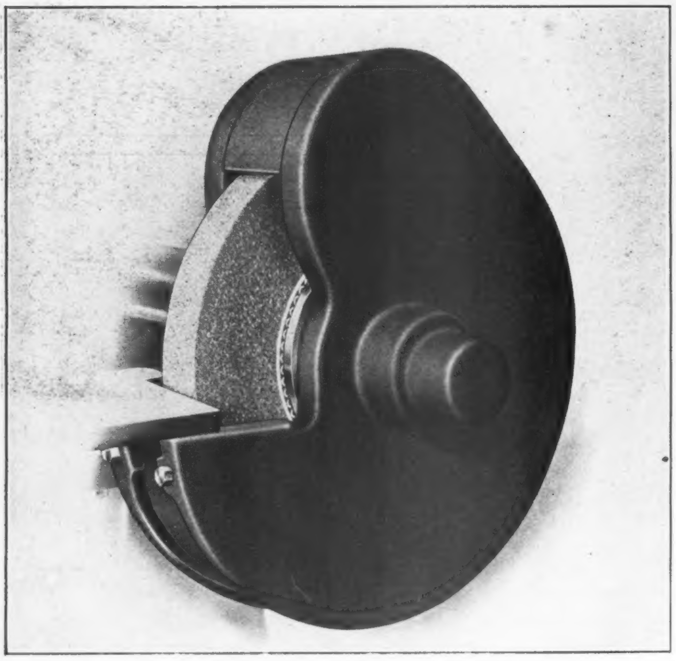
Mounting a wheel so that the nut works loose will cause the

wheel to run badly out of true. This can happen when a machine is taken apart for repairs and the spindle is turned end for end in setting up the machine again; or the motor or shafting which drives the machine may be changed so that it will revolve in the wrong direction; or when putting on a new belt an unreliable workman may use a twisted instead of a straight belt.

PROTECTION DEVICES

There are two acknowledged ways of providing protection to an operator in case the grinding wheel breaks while in operation. One is to surround the wheel, as much as operating conditions allow, with a well designed and substantial protection hood; the other is to use what is known as a beveled wheel in connection with flanges of a corresponding bevel. Beveling a wheel causes it to present a wedge shape and the theory is that should the wheel break, the pieces will be retained by the flanges, due to the wheel being thicker at the center than at the point where the outer edges of the flanges bear against the wheel. The large users of grinding wheels were recently consulted with the object in view of finding out which type of protection was being used. A good many replies showed a preference for the protection flange method. This was probably due to the fact that such experience as had been had with protection hoods was with designs which were not heavy enough or were made of weak materials. Unfortunately, there are hoods in use today which would not prove adequate in case of accident.

In order to determine the relative value of an approved type of protection hood and approved beveled steel flanges, breakage tests were conducted under actual working speeds. It was observed that in none of the hood tests did a piece of the wheel leave the hood in a way that could have caused damage. The tests show conclusively that a well designed protection hood, made of the right material, and properly adjusted, affords ample protection for straight-side wheels even when they are mounted between standard straight relieved flanges one-half the diameter of the wheel. It is possible to break pieces from a wheel by a severe blow when there is only 2 in. of the wheel projecting beyond the flanges. With protection flanges, no matter how little the wheel projects beyond the flanges, an operator has no protection from injury in case a piece of the wheel breaks off outside of the flanges, whereas with a hood protection is almost absolute.



Norton Model D Protection and Dust Hood

Protection flanges cannot offer complete protection, but in instances where a hood would interfere with the proper use of the wheel, flanges offer the next best method of protection.

DUST EXHAUST SYSTEMS

A number of the states have enacted laws requiring the removal of dust from dry grinding and polishing operations. Some of the states have even gone so far as to establish definite specifications for the size of dust exhaust systems, the amount of suction to be maintained in the pipes, etc. While this is a step in the right direction, nevertheless, some of the requirements seem to be unjust in that dust produced by grinding wheels can be satisfactorily removed with smaller pipes and less suction than the laws require. It is essential that the dust exhaust system be kept in proper repair and that the opening from the hood into the pipe be kept free.

Protection Hood, Leather Spark Brush, Gloves, Goggles and Proper Rest Adjustment

GOGGLES AND SPARK SHIELDS

There are several satisfactory designs of goggles for grinding, and every operator doing snagging work should be required to wear them. Since the particles cut off by grinding wheels are comparatively small, a heavy type of goggle is not necessary. Goggles should have side guards of wire or leather as particles coming from one side have been known to enter the eye. A glass spark shield which can be attached to the top of a protection hood is found very satisfactory where wheels are used intermittently. It is recommended that wire glass be used. Glass spark shields have not been found entirely satisfactory where wheels are used continuously, due to the fact that the glass soon becomes pitted from the heated chips of metal.

Another form of protection from grinding wheel sparks is a device consisting of a piece of leather attached to the top end of a protection hood and extending down over the face of the wheel, a slot being cut in the leather the approximate width of the grinding wheel.

DRESSERS

Grinding wheel dressers are sometimes the cause of accidents. If the work rest is not properly adjusted there is possibility of the dresser being caught between it and the wheel and the revolving cutters sometimes break into pieces large enough to cause serious damage. A type of dresser is recommended which has a hood as an integral part of the handle, the hood serving to protect

the user in case the cutters break. The ordinary type of dresser can be made more safe by attaching a thick guard of sheet iron over the cutters.

There is great need for the standardization of grinding wheel protection devices. This subject is to be taken up in the near future by the National Council for Industrial Safety and the National Machine Tool Builders' Association. These two organizations will consider all the important phases of this subject and endeavor to arrive at specifications which can be adopted as standard for protection devices used in connection with grinding wheels.

MACHINE TOOL REPAIRS

J. B. Hasty, Atchison, Topeka & Santa Fe: All machines for general repairs are taken to the tool room, dismantled, and all serviceable parts used. Small cast iron gears that require renewal are replaced with steel. Light repairs are made throughout the shop by repair men from the tool room. All repairs and renewals to shop machinery and tools are charged to a separate account, and the different departments are designated by a letter. The machines have serial numbers, and the record is kept as to their location, and the work done on them by the repair department. The classes of repairs are designated by Nos. 1, 2, 3, 4 and 5, according to the amount of work which is done on them.

John Tothill, Buffalo, Rochester & Pittsburgh: To handle the machine repairs, a man should have a broad experience and be thoroughly interested in his work to get the best results. Plenty of shop space should be allotted to this work, and it should be thoroughly equipped with the necessary tools and appliances. Every machine should be given a shop number when purchased, and accurate record kept by the man in charge of machine repairs as to the amount expended on each machine. A full set of catalogs of all tools in service, covering repair parts, should be readily accessible to the repair man so that he can order promptly and anticipate repairs to tools that are wearing fast, thereby causing a minimum delay to the work of the machine. The machine that is broken should be given the proper attention and repaired in a workmanlike manner.

G. W. Smith, Chesapeake & Ohio: Machine tools require a great deal more repairing at the present time than in former years, owing, principally, to the introduction of high speed steel and greatly increased speed. It does not seem to be the upkeep incident to long service any more, but rather the breakage resulting from overstrain in the majority of the cases. In order to overcome this situation we strengthen, wherever it is possible, broken gear wheels, worm wheels, worms and racks with Bessemer steel, and they are stronger than the parts which were previously broken. It is believed to be a serious mistake to operate a machine that is very badly run down. Repairs should have been made before the machine got in this condition. However, it is difficult to get hold of these machines as the shop is so very often rushed that they cannot be spared. In making repair parts of machine tools it is found very economical to keep one or more extra castings or other parts that have been machined, so that they may be used in case of a second breakdown, thereby saving time and getting the machine back into commission much sooner.

DISCUSSION

There was some difference of opinion as to whether parts of machines that have failed should be replaced by stronger material than the original parts, but it was believed that in some cases this was perfectly proper. However, care must be taken not to strengthen those parts that will cause some more intricate and expensive part to fail the next time the machine is put under undue strain. It is probably safe to replace broken parts of new machines that are performing the work intended for them by the builders by parts of the same material. In parts that have worn out it may be satisfactory to replace that part with some material of better quality. Bronze and steel have been found to make the best worm wheel and worm where they were called upon to do heavy duty. Good cast iron case hardened for the worm has also given very good results.

Mr. Shaffer, of the Illinois Central, strongly urged that those men who were responsible for machine repairs keep a cost system, so that it would be possible to estimate the cost of repairing future machines whenever they failed. By this method it will be possible to determine whether it is economical to repair the machine or to buy a brand new machine. Oftentimes it will be found cheaper to make the broken parts in the shop, rather than to wait for a shipment from the manufacturer. At Silvis there are four men under the tool foreman that do all the machine tool repairing, which includes pumps, engines, etc. One man is kept constantly inspecting all the machinery and cranes looking for parts that are unduly worn, and that may be expected to fail, making note of the parts and seeing that duplicate parts are obtained and held in stock in case of failure. This has done a great deal to reduce the loss of time when machines break down.

The life of air motors varies, according to the members, from one and a half years to three years, and it was pointed out that an accurate cost of repairs of each motor should be kept, so that when the repair cost becomes too high new ones can be ordered. All kinds of difficulties were mentioned with keeping strainers in the hammers and motors taken out by the boiler makers. One member reported that he found it cheaper to clean the hammers out than to try and keep the strainers in. However, if the boiler makers can be made responsible for them no trouble should be experienced. On the Texas & Pacific the air motors are given a kerosene bath for four hours every three months, and well lubricated. This practice will give a life of three years at an average expense of only $10. The air hammers are put in a bath of two-thirds kerosene and one-third signal oil every night as they are turned in.

DISTRIBUTION OF SHOP TOOLS

Henry Otto, Atchison, Topeka & Santa Fe: The tool room of a locomotive repair shop is one of the most important, but oftentimes one of the poorest equipped and most neglected departments in the whole shop. In many instances it is located in an out-of-the-way corner, causing the workmen who are in need of tools to waste time going back and forth. In properly planning a tool room it is necessary to consider the distribution and care of small tools, special tools, jigs, air motors and hammers, etc. Large repair shops have, as a rule, a main tool room and one or more tool issuing rooms; also a practical checking system, which must be installed to keep a record of all tools issued. On the Santa Fe a number is assigned to a new man, and he is sent to the tool issuing room where he is furnished with a standard kit of tools according to the department and class of work he is to perform. That man is held responsible for these tools until they are returned, the tool checker keeping an account of the tools furnished, which the workman is supposed to sign. He is then given checks with which to draw other tools. The machine shop men have eight checks, the erecting shop men five checks, boiler shop men ten checks, and all other men five checks. All tools drawn out on check are required to be returned to the tool room on the last working day of each week for inspection. Any one failing to comply with this ruling is reported to the general foreman. If a workman breaks a tool he is required to get a tool-breakage clearance card signed by the department foreman, before he can redeem his check. Lathe, planer and shaper tools, hand drills and soft hammers are replaced without a clearance card from the foreman.

The tool breakage clearance cards are placed on file by the tool checker, and at the close of the month are given to the tool foreman, together with an invoice of the tools on hand in the tool issuing room. The tool foreman checks over the clear-

ance cards, and determines the number of tools to be purchased. The clearance cards are then turned over to the supervisor of tools who makes out a statement which is sent to the superintendent of shops, thereby keeping him fully advised as to the tools damaged.

When an employee leaves the service the department foreman writes an order for the time check. This order is taken to the tool checker, who either approves it or makes a notation of the number of tools or tool checks missing. The workman is charged for each tool that he fails to surrender, the amount being deducted from his pay check. If any of the standard tools in the storehouse run low the supervisor of tools issues an order to the general storekeeper, who, in turn, makes out a shop order to the tool manufacturing department for the tools required.

J. T. Fuhrman, St. Paul, Minn.: The manner of distributing the tools depends upon the size of the shop. In small shops with a small number of men, and a short distance to walk to the tool room, all tools should be kept in one place. In large shops where hundreds of men are working who are divided into gangs conditions may be different. I would suggest a cupboard or locker in every gang to keep wrenches, air hose, etc. Special tools which are only used by certain men may be kept there in charge of the foreman. The arrangement of racks should be given careful attention. All the tools should be classified, and kept in good order.

W. E. Ross, Baltimore & Ohio: The plan of the tool room will be different for different shops, and where necessary department tool rooms should be used. It is believed that the messenger service, if perfected, will give much better results than to have the men call for their tools. The messenger boys are stationed in the tool room, and are called to various parts of the shop by means of an annunciator. All tools should be given a thorough inspection before they are replaced on the racks.

John W. Nutt, Chicago Great Western: The tool room counter over which the tools are handed out should run the full length or width of the tool room, and should be so arranged as to permit the placing thereon of the tools most frequently called for, such as hand taps, die nuts, stud nuts, gages, etc., so that they shall at all times be accessible to the tool passer. Various other tools may be placed on revolving racks located immediately behind and parallel to the tool room counter, readily accessible to the tool distributor. Each gang foreman on the erecting side of the shop should have a tool cupboard where tools, such as wrenches, hand punches, a set of die nuts, stud nuts, etc., may be kept. These cupboards should be in charge of a tool boy, who will hand out the tools. All motors, air and electric, should be returned to the tool room to be examined and thoroughly oiled at the end of each week, and all air hammers should be returned every evening. No method of handling tools, however good, will operate successfully without the hearty co-operation of department foremen, and their being watchful of the care of tools while in the hands of the men under their jurisdiction. Competent men should be selected to take care of the tool room counter; men who are able to detect an abused tool and make full report of every irregularity.

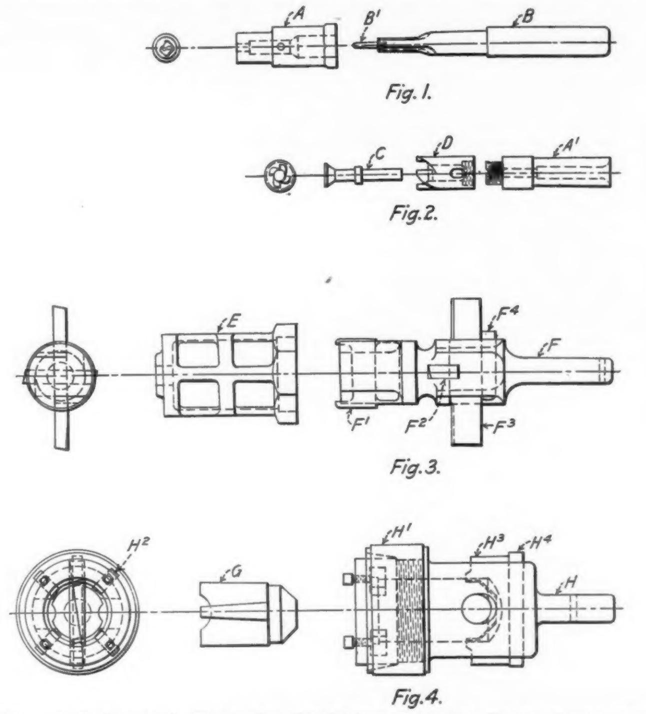
DISCUSSION

All members were agreed that in order to have a satisfactory tool distributing system the co-operation of all the foremen in the shop must be such that the men will handle the tools properly, and see that they are always returned. All agreed on a definite system for keeping track of all the tools sent out. A little tact on the part of the tool distributor will go a long way in helping the tool foreman out in the matter of lost tools and keeping the tools in good shape.

SPECIAL TOOLS

J. J. Sheehan, Norfolk & Western: In making special tools, every effort should be made to have them as simple as possible, making the simplicity the controlling feature.

Mr. Sheehan presented the following illustrations: Fig. 1 represents a drain cock body and the tool for making it; *A* shows the complete body; *B* the main body of the drill; *C*-1 the inserted drill point which drills the lead hole, thus com-



Figs. 1, 2, 3 and 4—Tools for Finishing Cylinder Drain Cocks and Relief Valves

pleting the drilling and forming of the valve seat in one operation. Fig. 2 shows the valve for the drain cock body in Fig. 1 and the tool for turning it; *C* is the complete valve; *A*-1

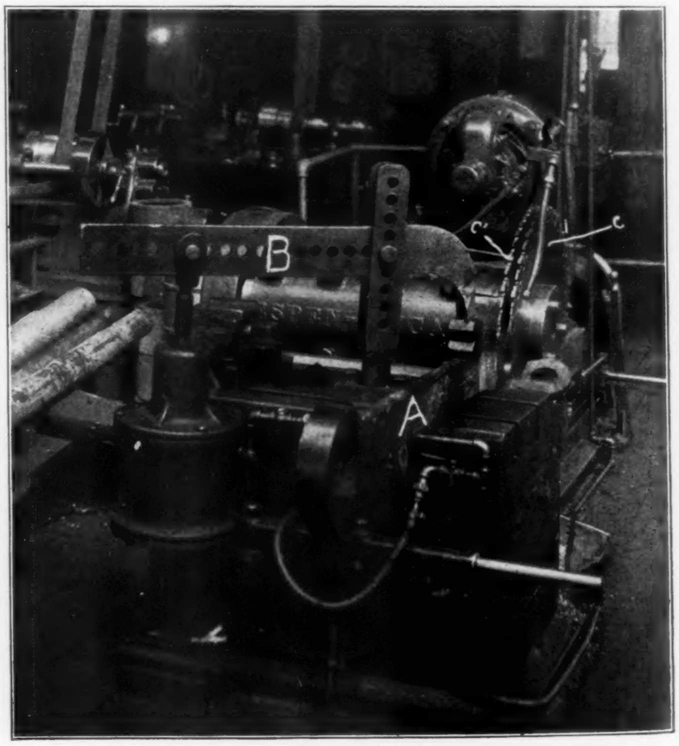


Fig. 5—Cutting Jaws in Locomotive Side Rods

and *D* represent the tool complete. Fig. 3 is the cage for the cylinder head release valve and the tool for finishing it. *E* is the finished part, except for tapping; *F* is a soft steel body holding the forming blades; *F*-1 is the leading blade which bores

the body to size; *F*-2 is a counter boring blade; *F*-3 is a facing blade, and *F*-4 is the key that locks the blades in place.

Fig. 4 is a hollow forming tool for turning the valve for the cylinder head relief valve; *G* is the complete valve; *H* is the tool holder; *H*-1 is the adjusting nut for holding blades *H*-2;

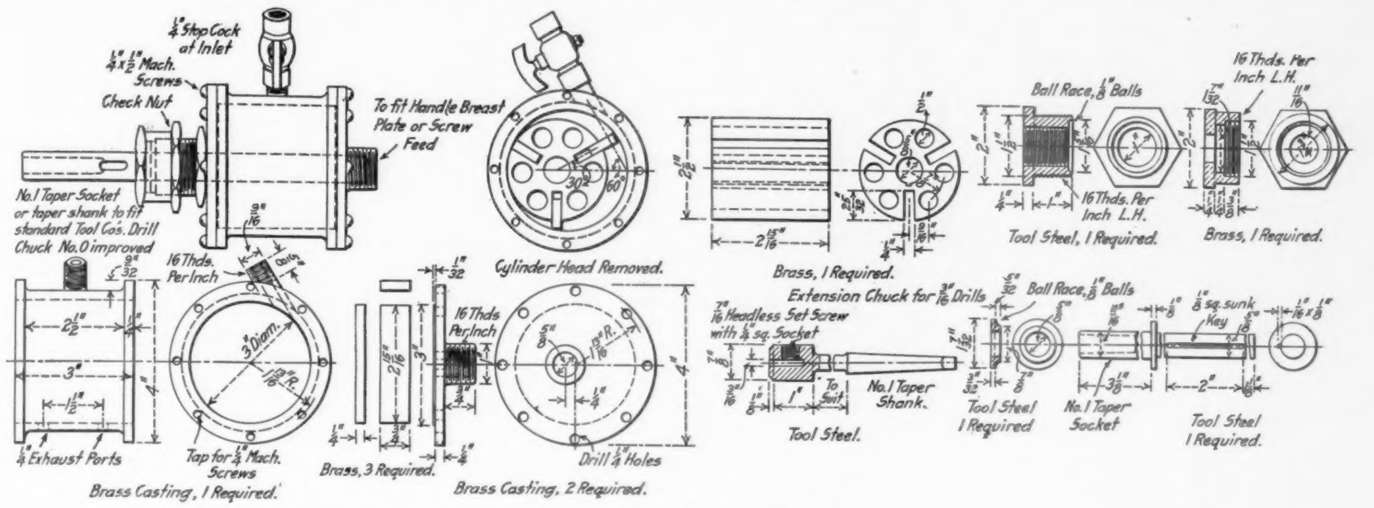


Fig. 6—Air Motor for Light Drilling

H-3 is the seat forming blade held in place by the key *H*-4. Fig. 5 is an arrangement for cutting the jaws in locomotive side rods; *A* is the rod to be operated on; *B* is the pneumatic clamp which holds the rod *A* in place; *C* and *C*-1 are inserted tooth

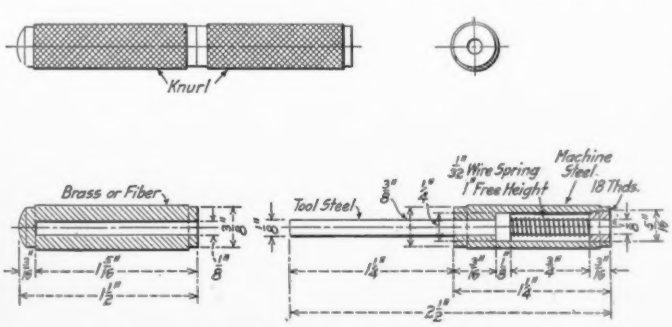


Fig. 7—Depth Gage for Telltale Holes

saws 30 in. in diameter. The saws are spaced the required distance to complete the operation which is done in 15 min., floor to floor.

Thomas F. Eaton, Baltimore & Ohio: We use a special

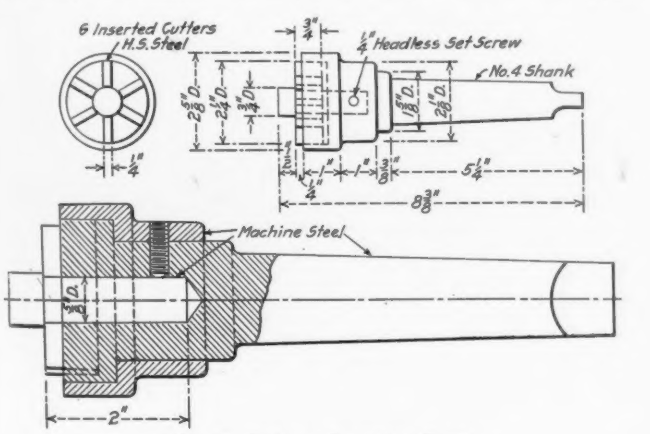
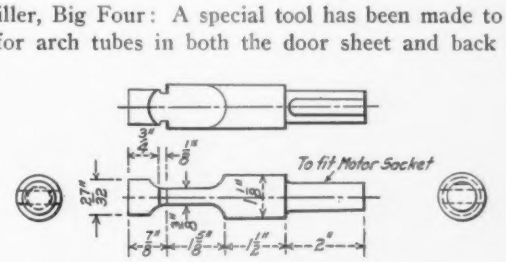


Fig. 8—Rotary Scarfing Tool

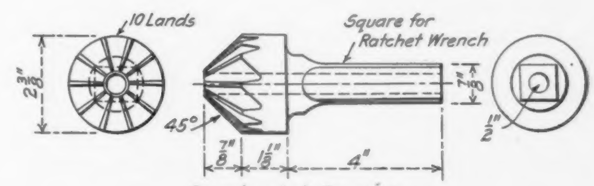
reamer for making one large hole in the tube sheet so that tubes may be drawn out easily. This reamer is of the shell type with a No. 4 shank screwed into the back, 3 in. long, tapered half way back to 3/32 in. smaller at the front end. It is cut spiral with a lead of 60 deg. to one turn. It is 5 11/16 in. in diameter, has 25 teeth which are fluted, with a convex cutter. For superheater heads we used a 45-deg. reamer, with a No. 2 Morse taper shank inserted to suit a small air motor. These reamers are made from high speed steel. They have 25 teeth and are ground with 6 deg. clearance. They are milled with a 60-deg. cutter. We have made only our special taps and have given these from .001 to .003 in. clearance according to the pitch. The following is a table of dimensions for special milling cutters:

Diameter.	Number of teeth.	Flute Angle.	Clearance Angle.
6 in.	29	70 deg.	3½
10 in.	37	60 deg.	3½
5 in.	22	65 deg.	5½
6 in.	25	65 deg.	5

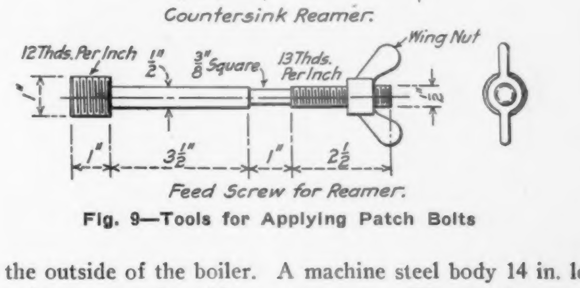
H. B. Miller, Big Four: A special tool has been made to drill the holes for arch tubes in both the door sheet and back head



Flat Drill for Counterboring First Sheet.



Countersink Reamer.



Feed Screw for Reamer.

Fig. 9—Tools for Applying Patch Bolts

from the outside of the boiler. A machine steel body 14 in. long was made to cover the widest water space. The end is counterbored 1 in. deep and has ⅜ in. wall. The end is also drilled for a pilot which is fluted so as to be used with staybolt holes. This cutter will bore through both holes in 4 min. The blades are

made of high speed steel and are inserted with a tongue and groove. They cost $2.05 each. It has been the practice to use reclaimed high speed steel in inserted blade Rose disc reamers for all sizes, but in making reamers under 1½ in. in diameter we have found it more economical to make these reamers of carbon steel, as the high speed steel blades were so much stronger than the bodies that the bodies were twisted, causing the blades to break. We have made some inserted blade milling cutters with a machine steel body 5¼ in. in diameter of body, the blades projecting ⅜ in. The blades are set at an angle of 11¾ deg. spiral and after being inserted are turned up in the lathe and

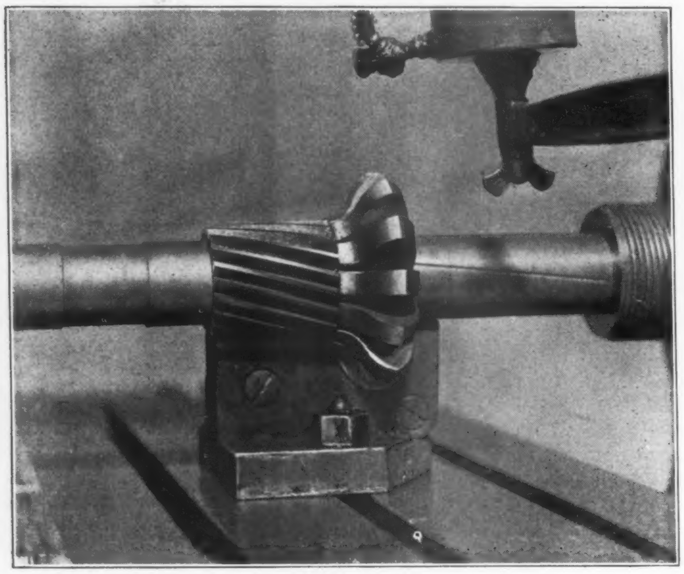


Fig. 10—Milling Cutter for Machining Wheel Lathe Tools

the face of the blades is milled to the two spirals. Chip breakers are milled in the blades. These cutters have given good service on rod work.

R. Dolensky, Southern Pacific: Fig. 6 shows an air motor designed for light drilling, which drives drills up to ¼ in. diameter with good success. These motors were manufactured at a cost for material and labor of $15 per motor. They are used primarily for drilling 3/16-in. telltale holes in staybolts. Their construction is simple and the maintenance costs are very small. The

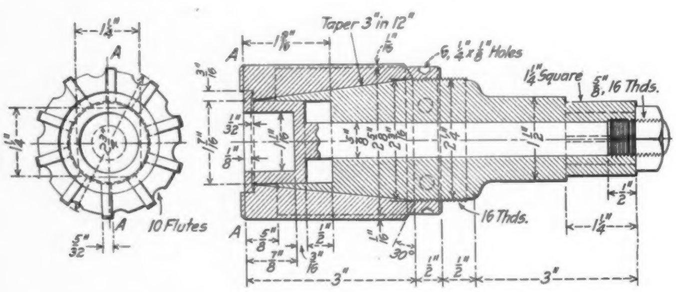


Fig. 11—Cylinder Body Reamer for Westinghouse Air Compressor Governor

use of these motors has made an actual saving of 50 per cent. in drills, which were broken while using the expensive piston type motors. Fig. 7 shows a depth gage for telltale holes. With this gage the inspector is able to test the depth of holes by simply keeping his finger over the end of the gage. If the plunger under his finger remains flush with the end of the gage he knows that the hole is of the correct depth.

Fig. 8 shows a rotary scarfing tool used for scarfing down the flanges on new flue sheets preparatory to countersinking the rivet holes. The inserted cutters in this tool are of high speed steel and are taken out for grinding. This tool saves considerable time and leaves a finished surface. Fig. 9 shows a combination set for application of patch bolts by hand. This set is used to advantage in applying patch bolts in places which are inaccessible for a motor. Fig. 10 shows a milling cutter designed for machining and resharpening high speed steel forming tools for finishing driving wheel tires. The forming tool is annealed, bolted to the milling fixture as shown, milled and rehardened, then being ready for service on a driving wheel lathe. The cutter is made in two pieces and is of high speed steel. It has been in service for four years.

W. L. Stephenson, Atlantic Coast Line: Designing special tools requires genius, care and above all things hard work. The first thing that must be known before proceeding to manufacture any tool is the amount of work to be done, the simplicity of the tool, its maintenance, its efficiency and the cost of production.

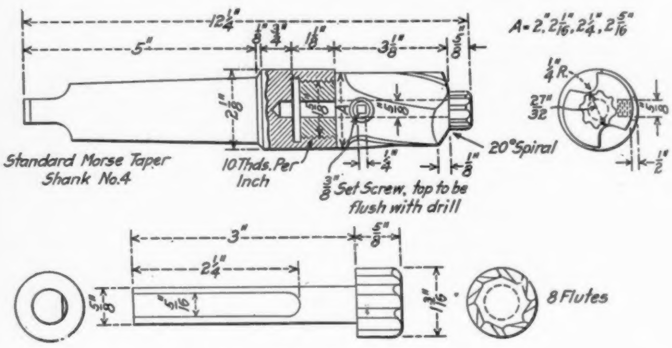


Fig. 12—Flue Hole Cutter

The next thing is to carefully select the material of which the tool is to be made. We use a tool for drilling all sizes of flue sheet holes, except on superheater engines. The body carries two blades which may be adjusted to the required size. They are controlled by a screw and held in two blocks by two set screws. The screw has a plate that is graduated in sixty-fourths of an inch, which allows the blades to be set at any size by reading the plate. One cutter has a V-shaped cutting face, the other a square. This enables the cutters to stand heavy feeds and high speeds. The cutters are ground so the burrs can be removed from the holes immediately after the hole is drilled before re-

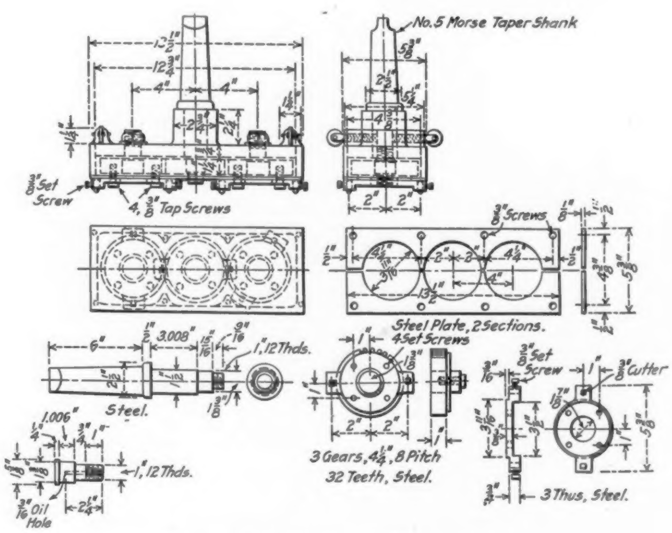


Fig. 13—Oil Groove Cutting Device

moving the tool. The holder has a reamer for piloting the blade 15/16 in. in diameter and milled with four flutes and no clearance. The holes are punched to ⅞ in. in diameter, which leaves 1/16 in. for the reamer pilot to remove. This is done in order to hold the cutters in place. The body is made of nickel steel and the blades and pilots of high speed steel. With this tool we can

drill approximately one hole every 40 seconds, fluting all sizes. For rods and crosshead work we use a solid reamer. We use five different reamers for motion work, having seven or nine teeth, according to the size. It is obvious that the greater the number of cutting edges we have, the more line of contact there is to steady the reamer on the walls of the hole. By providing coarse teeth it enables the reamer to be ground faster without drawing the temper, and the cutting edges can be made to cut faster. These reamers are milled with an 8-deg. left hand spiral. I find in providing spiral teeth we maintain a uniform cutting duty which causes the cutting edges to proceed gradually, thus relieving jumping and strain on the machine and giving a smooth finish to the work.

W. E. Goodwin, Chicago & Alton: Fig. 11 shows a reamer for reaming a 1¼-in. Westinghouse air compressor governor body. As these bodies are reamed to ⅛ in. over size it makes it very convenient and economical to have an expansion reamer to do the work. The adjustment is made by loosening nut *A* and tightening up on nut *B*, giving an adjustment of ⅛ in. Fig. 12 shows a flue hole cutter. The cutter part is made of high speed steel screwed into a vanadium steel shank which can be quickly detached. It has also a detachable pilot so that it can be removed when grinding. This makes a very efficient cutter and reduces the upkeep to a minimum. Fig. 13 shows a special tool for cutting oiled grooves in driving boxes on the shoe and wedge bearing. The tool is designed with a triple bearing with two cutters on each gear and so arranged that the grooves will come together with the center ring. The tool has a roller bearing on each side to fit against the driving box jaw and keep it from turning.

DISCUSSION

O. D. Kinzey, Illinois Central: All new milling cutters we are making with the wide spacing of the teeth, following the recommendation of the Cincinnati Milling Machine Company. We use coarse teeth and we have doubled our milling machine work. You can take a cut that appears to be ground on the grinding machine, and do it with high speed and a heavy feed. The old styles are obsolete in our shop. Another thing we have done on milling machine work is to increase the diameter of our arbors to 1½ in. The common arbor for tool room milling machine is 1 in., and it is too light. The 1½ in. arbor permits us to double our milling work. All new cutters are made with a 1½ in. hole. We have been handicapped with milling machine work which caused us to look into the matter and we have doubled our work.

We use what is called a helical cutter for milling piston rods. We make these cutters ⅝, ¾, 1 and 1½ in. in diameter. They resemble a twist drill in appearance, only they have three flutes and a very abrupt spiral. We will mill in a piston rod in twenty minutes, driving the cutter by an air motor. We have done away with the old power chip breaker we used to put in. The chip breaker is obsolete for modern practice. If you are not going to use much spiral, use a chip breaker. Another new practice is to make the cutting edge under-cut, so that the milling cutter works similar to a lathe or a machine tool. Get a lip on the milling cutter. With it you turn out chips of remarkable shapes. I think modern milling machine practice is one of the greatest opportunities to produce results before the tool foreman today. I have doubled our work and there is a great deal more to be done before I get up to where I should be.

B. Hendrikson: Don't you think the success of the machine depends on the tempering of the tool? It is pretty hard to get a tool to stand up over a certain speed.

Mr. Kenzie: It depends on the construction of the milling cutter. With the under-cut and the increased spiral tool the heat generated at the point of the tool will dissipate more rapidly, allowing increased speed. For manganese rails they use soft steel cutters that have been put through a case hardening process, and they are handling that work where the ordinary cutter would not stand up at all. It shows what can be accomplished under scientific manipulation.

G. W. Smith: On our milling machines for rods, especially for channeling rods, we have two cutters. They are what I term a zigzag cutter and they do very effective work. There seems to be no limit to the cutter, but the limit seems to be to the machine. The machines do not seem to be able to stand up for the cuts that are put on them.

Mr. Kenzie: I notice that some are still shaping the collars of rods and doing the milling on a planer. A milling machine will produce a perfect job and will do it in half the time. In regard to Mr. Smith's remarks as to the zigzag cutter, it is a very efficient cutter. We have made several experiments on that new style cutter with the wide spacing of teeth, probably not having more than ten teeth in it, and tests showed that it took less power than the other cutter. When you have a great number of teeth you have to embed more cutting edge in the metal at one time.

A. R. Davis: In the last year I made quite a number of special cutters for milling out the rod jaws for connecting rods. We made a set ranging from 1 15/16 up to 3½ in. in diameter. The blades were high speed steel and inserted in a machine steel shank on the same principle as the Richmond drills are—very coarse flute and the angle of the spiral was 37½ deg. That is as far as I could swing the table around. Those cutters have proven very efficient. We are milling our side rods and middle connection straps. The width of cut will vary from 7½ to 15 in.

COLD PUNCHING DIES

C. Henrikson, Chicago & North Western: In boiler sheet punching the first important item is to choose the proper kind of material. The best steel for this purpose is one of low carbon content, about 85 points for both the punch and dies, which should be hardened. The temperature at which the hardening is done should be determined by the carbon content, the higher temperature for the low carbon and the lower temperature with the higher carbon. The approximate temperature should be between 1,700 and 1,800 deg. Fahr. For ordinary boiler punching on holes of ½ in. in diameter and greater, the hole in the die which receives the punch should be 1/16 in. greater than the diameter of the punch. We do not find it necessary to manufacture any of the dies ourselves, as they can be purchased very satisfactorily on the market.

The punches used for sheet iron, tin, copper and brass are commonly called blanking dies. This type of die should preferably be made of a special steel of high carbon content, about 110 points. The method of manufacture varies according to the type of the die. The die is sometimes forged to shape and at other times made directly from stock. The tempering of these dies should be carefully done in order to avoid warping. Where dies are not too large and are symmetrical in shape, oil should be used for the tempering bath. Where oil cannot satisfactorily be used, water is used for the cooling bath. The electric furnace is generally used to heat the dies to the required tempering temperature, which should be between 1,400 and 1,500 deg. No clearance is allowed between the punch and the die in this case. For dies on sheet iron a slip fit should be allowed. Both the die and punch should be hardened. For dies used in punching the tin the fit between the punch and the die should be tight. The plunger is left soft, only the die being tempered. By doing this it is possible to upset the punch by hammering when either the punch or die becomes worn. The following is a list of some of the punching done at the Chicago shops by the use of blanking dies: air pump gaskets, hose strainer blanks and different sizes of guide liners and pipe gaskets. The centers of large gaskets are used wherever possible to punch smaller size gaskets. The method of making dies for leather and rubber is practically the same as that used in making blanking dies. A sort of boss is formed

around the recess of the die and a recess is formed in the punch. Both punch and die are hardened and no clearance is allowed.

DISCUSSION

From the discussion it was pointed out that an ingenious tool room foreman could save a great deal of money by designing dies that would turn out work in an economical manner. Some members recommended a clearance of 1/10 of the diameter of the punch. Work that has been done with the punch press includes emery wheel dressers, beading tool gages, guide bar liners, pipe clamps, and M. C. B. wheel defect gages. Some find it necessary to temper these gages and finish them up in the milling machine, while others harden them directly after they are punched.

CLOSING EXERCISES

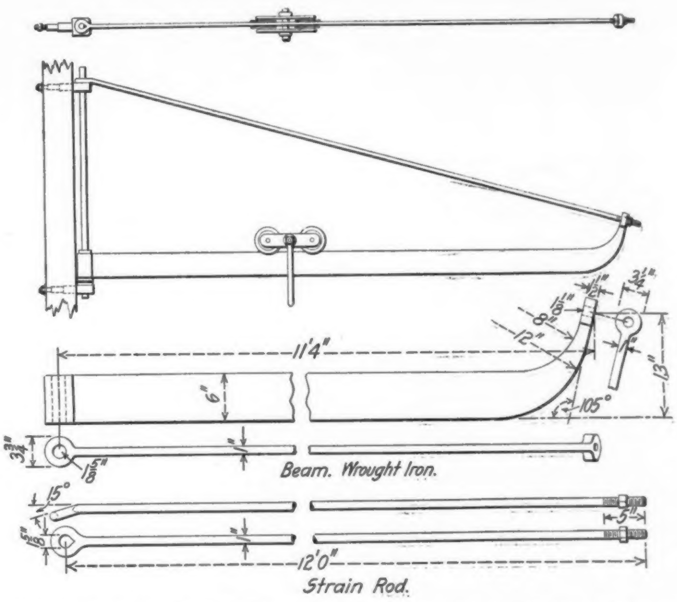
The following officers were elected for the ensuing year: Henry Otto, Atchison, Topeka & Santa Fe, president; J. J. Sheehan, Norfolk & Western, first vice-president; C. H. Shaffer, Illinois Central, second vice-president; J. C. Bevelle, El Paso & Southwestern, third vice-president; Owen D. Kinsey, Illinois Central, Chicago, secretary and treasurer. Chicago was chosen as the place of the next meeting, which will be some time next July.

BALL BEARING COLUMN CRANE

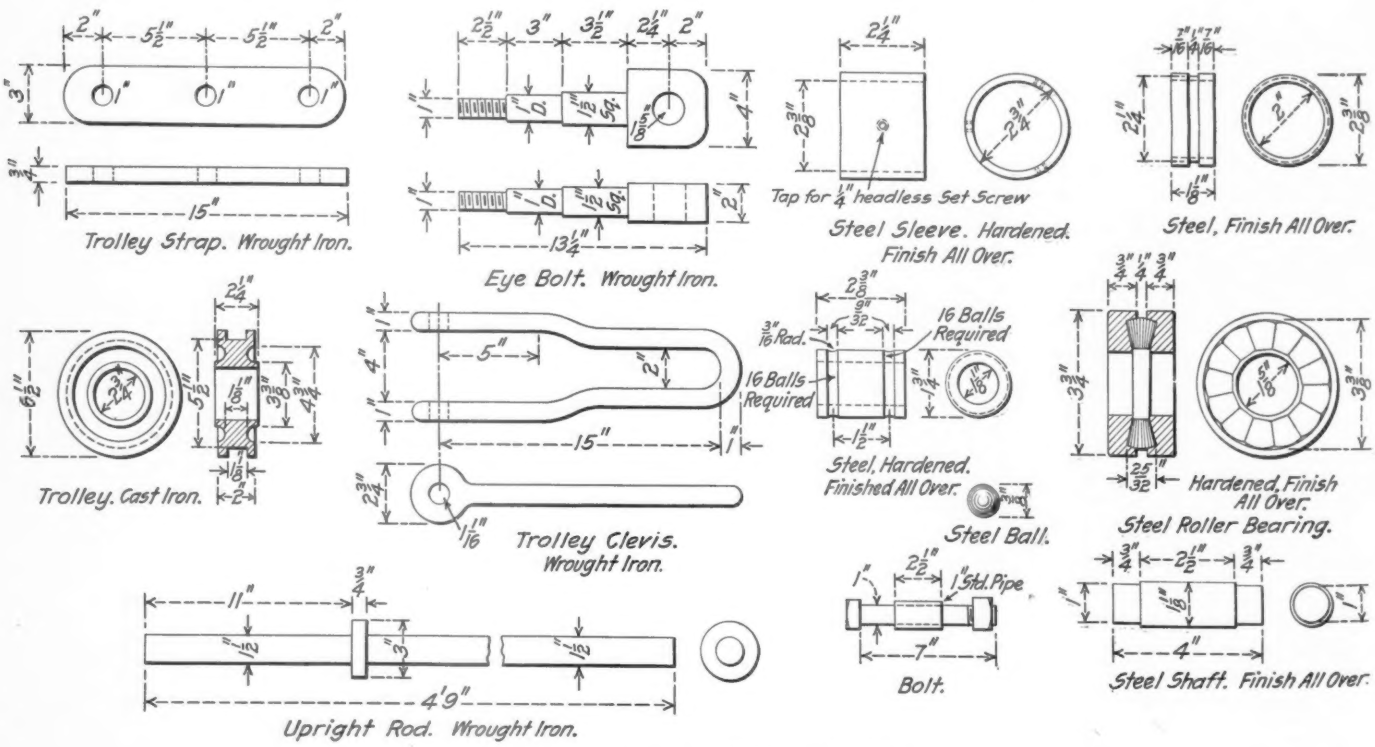
BY W. H. WOLFGANG

In shops where floor space must be economized and will not permit of erecting a self-supporting jib crane, a crane of the type shown in the drawings may be secured to a column of the building.

The beam of this crane is made from 1 in. x 6 in. wrought iron or steel. Eyes are forged on the ends of the beam, the brace or strain rod being secured to the curved end and the crane post passing through the other end. The post is made from $1\frac{1}{2}$ in. round iron and revolves in two eyebolts which are secured to the column of the building. The frictional resistance of the beam is greatly reduced by the use of a roller bearing which is shown in detail. Ball bearings are also provided for the trolley wheels. The wheels and ball bearings are supported by $1\frac{1}{8}$ in. shafts, the ends of which are reduced to 1 in. in diameter where they fit into the side straps. A 1 in. bolt passing through the side straps between the wheels supports the trolley clevis and also secures the side straps against the shoulders on the shafts. This crane has a working capacity of one ton.



Simple Ball Bearing Crane for Attachment to a Building Column



Details of Ball Bearing Crane and Trolley

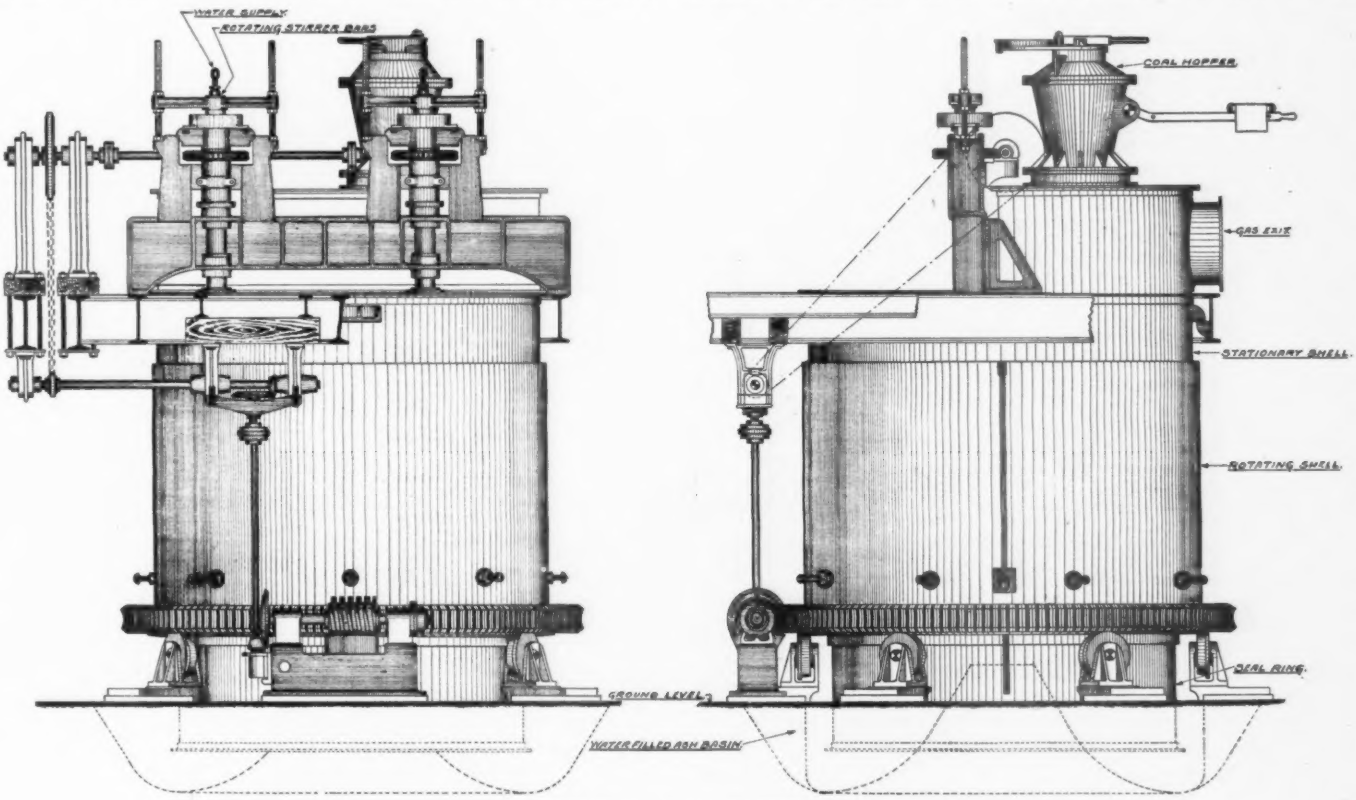
Railroad Accident.—On Monday afternoon, as the locomotive and train of cars, from Saratoga to Ballston, came to where the old Saratoga road crosses the railroad, about half a mile east of the latter place, a one horse wagon, with a man and woman in it, stopped on the track; the engine came up at the moment, crushed the wagon, killed and mangled the woman in a shocking manner, and killed the horse—the man escaped uninjured.—*From the American Railroad Journal, September* 5, 1835.

NEW DEVICES

GAS PRODUCER INSTALLATION AT THE JUNIATA SHOPS

A gas producer plant has recently been installed at the Juniata shops of the Pennsylvania, which was designed and built by R. D. Wood & Co., Philadelphia, Pa. The plant is made up of two mechanically operated gas producer units, each consisting, primarily, of three parts—the lower or revolving shell, the upper or stationary shell, and the foundation. The drawing shows the general construction. The lower shell contains the fuel bed from which the gas is generated. It rests on rollers which are supported from the foundation, and is revolved by an electric motor through a suitable train of gears. The coal feed and gas outlet are located on the stationary shell, and water-cooled stirrer bars extend into it from the top. charge. The feed is not automatic, but an automatic feed could readily be installed. The coal handling machinery consists of the track hopper, coal crusher, elevator and overhead bin. The overhead bin has a capacity of 50 tons of coal and is arranged with two chutes, one for each producer unit. The coal is fed by gravity from this bin to the charging hopper located on the producer top plate. A car of coal is dumped over the track hopper from which it is fed by means of a reciprocating feeder into the crushing rolls. From these rolls it is discharged into the elevator boot, the elevator discharging it into the overhead bin.

The ash formed due to the combustion of the fuel is withdrawn from the producer at the bottom through the water pit. Automatic ash removal can be arranged for, if desired. Clinker trouble in the fuel bed is unknown, since the action of the



Mechanically Operated Gas Producer at the Pennsylvania Railroad Juniata Shops

Both the stationary and revolving shells are lined with fire brick, the former having a fire brick crown through which the stirrer bars pass. The foundation contains a concrete basin about 6 ft. in depth, upon which rests the ash bed. This basin is filled with water, in which the lower part of the revolving shell is sealed to prevent loss of the air blast. The blast to the producer is carried in cast iron piping through the foundation and is delivered to the center of the producer about two feet below the top of the ash bed, a blast hood of special design being provided at that point.

The stirrer bars are steel forgings, and project down into the fuel bed to a point about 18 in. above the top of the blast hood. They are curved for about 4 ft. from the lower ends, and are rotated by gearing driven from the motor which operates the revolving shell. The effect of the rotating bars in the revolving fuel bed combines to produce complete agitation of fuel bed, and hand poking is entirely unnecessary. Coal is fed through a charging hopper, about 600 lb. being fed at one stirrer bars is such that little or no clinker can form. By continuous rotation of the fuel bed any clinker that may form is crushed, and is withdrawn through the water seal in sizes not exceeding that of a large walnut.

The diameter of the producer measured inside the fire brick lining is 10 ft. 6 in. Each unit is capable of gasifying or burning 2,300 lb. of coal an hour, continuously 24 hours a day. Two units were installed to furnish gas for use in the smith and boiler shops. The guarantee for the performance of these producers was so far exceeded, however, that it was found that one unit was ample for the requirements of the furnaces. One producer has been in operation for several months and is giving most satisfactory service. The gas furnished is of high and uniform quality, averaging over 150 B. t. u. per cu. ft. of standard gas. It is unnecessary to shut down the producer while ash is being withdrawn, practically no variation in gas quality being noticeable at such times.

The gas used in the furnaces is not cooled or cleaned in any

way, the heat from the producer being utilized, and the producer efficiency being thus increased to approximately 90 per cent.; that is, the gas leaving the producer contains approximately 90 per cent. of the heating value of the coal charged to the producer. Both air and gas are regenerated before entering the furnace hearth.

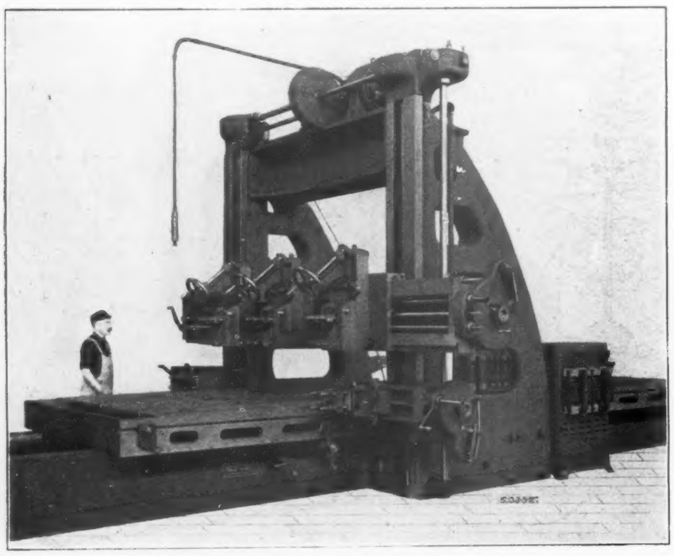
This installation replaces eleven producers of the old hand-poked type. It was necessary to operate seven of these in order to furnish the same quantity of gas that is now being supplied by one of the mechanically stirred type. The hand-poked type could not be operated continuously, it being necessary to take a unit off the line in order to clean the fire and withdraw ashes.

PLANER FOR LOCOMOTIVE FRAMES

The accompanying illustration shows a 96 in. by 84 in. locomotive frame planer recently built by the Niles-Bement-Pond Company. It is driven by a 75 horse power reversing motor and is equipped with electric feed and rapid power traverse for the heads.

The general construction of this planer is the same as that of the heavy planers built for the Commonwealth Steel Company by the Niles-Bement-Pond Company, which were described and illustrated in the Railway Age Gazette, Mechanical Edition, of June, 1914, page 323. The same facilities for changing cutting and return speeds, and the same methods of control are provided for both types of machine.

Three heads are provided on the cross rail of the frame planer, and one side head on each upright. The cross rail heads have



Planer for Locomotive Frames, with Electric Feed and Rapid Power Traverse for the Heads

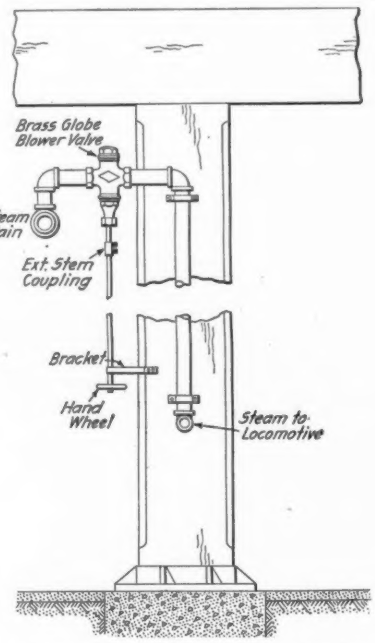
handwheels operating through bevel gearing for convenient adjustment of the tool slides.

An important feature of this machine is the electric feed and rapid power traverse which is provided for all heads. Both the feed and traverse are operated by a motor mounted on the arch. This motor is also used for elevating and lowering the cross rail. The mechanism for the different operations is interlocked in such a way as to prevent accidental engagement of two functions simultaneously. The amount and direction of the feeds for the cross rail heads can be changed at each end of the rail. The changes of feed for the side heads are made in a similar manner, the feeds for each head being entirely independent of each other and of the cross rail heads. The hand adjustment of the side heads is by a ratchet crank wrench which is mounted on and moves with the head. All heads have graduated swivels and micrometers on the feed screws.

The table is of heavy box section, without openings through the bottom wall. This gives a rigid construction and also prevents chips or cutting fluid from reaching the gears or tracks in the bed.

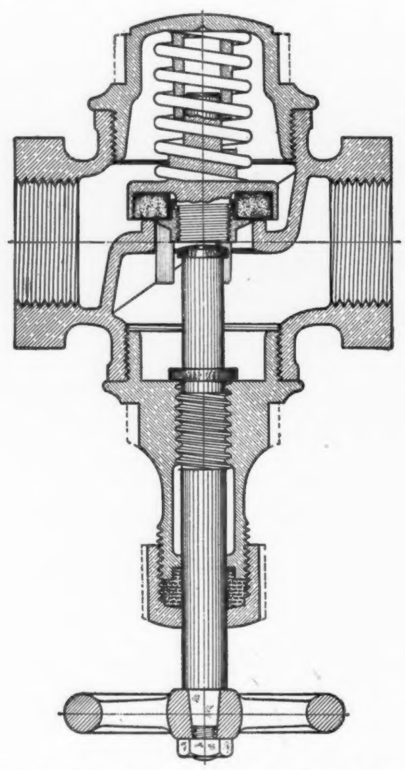
ROUNDHOUSE BLOWER VALVE

The globe valve shown in the illustrations has been developed by Jenkins Bros., New York, for use in roundhouse blower lines.



Position of Roundhouse Blower Valve in Pipe Line

The construction is clearly shown in the sectional elevation. By turning the handle to the left the stem forces the disc-



Sectional Elevation of Valve for Roundhouse Blower Line

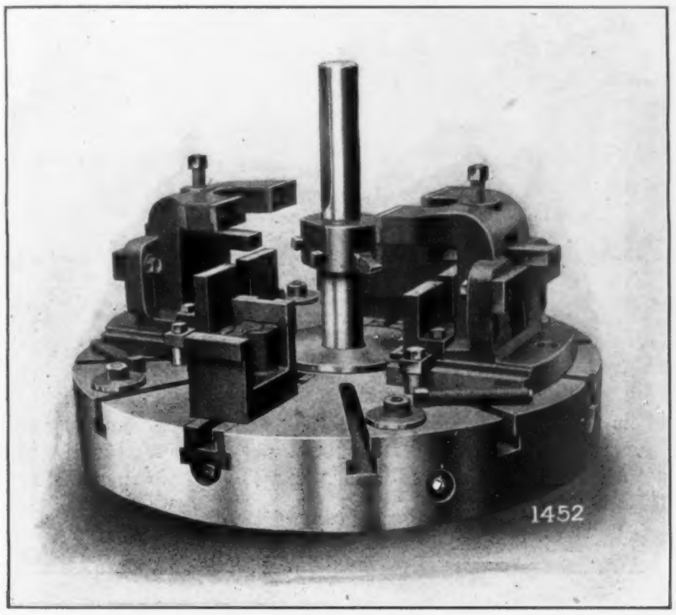
holder off the seat, thereby opening the valve. On turning the handle to the right the spring forces the disc-holder

against the seat, where it is firmly held by the steam pressure.

In one of the engravings the valve is shown in position in the pipe line, with the stem and hand wheel extended downward to a position convenient for operation. The valve is designed to permit a piping arrangement which will eliminate the trapping of condensation in the connecting pipes, with a valve seating from the top, in the usual manner.

DRIVING BOX BORING MILL

A 42 in. boring mill with a chucking device designed especially for handling driving boxes has recently been developed by the



Driving Box Chuck Used on 42 In. Boring Mill

Gisholt Machine Company, Madison, Wis. Considerable attention has been given to convenience in the arrangement of the

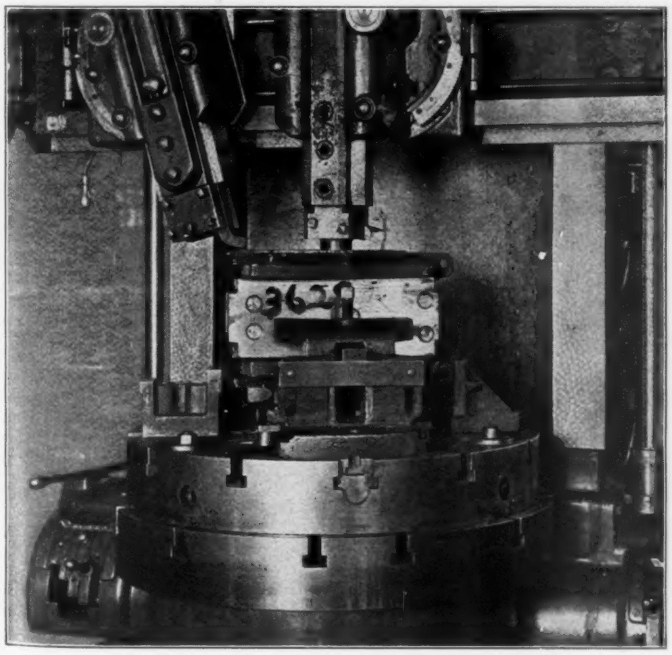
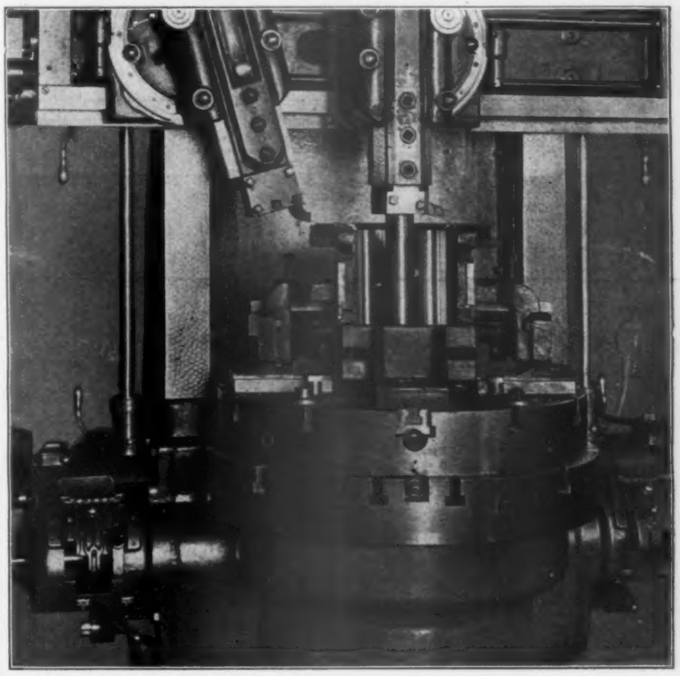


Table Turned to Show Independent Jaws and Long Bearing of Universal Jaws

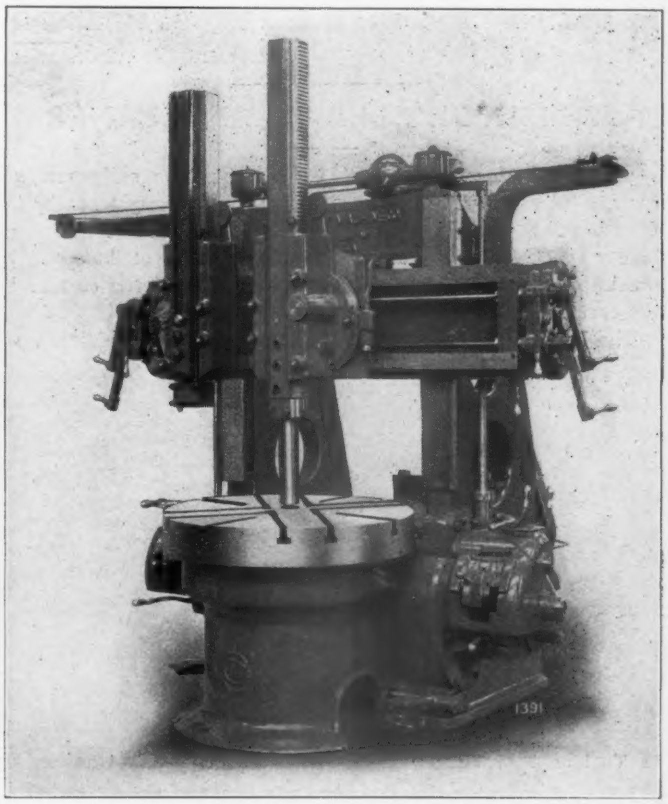
control and to the protection of the machine by means of feed tripping devices. The table may be controlled by duplicate levers on either side of the machine. There are two swivel heads, both of which are on the cross rail, one for the boring bar and the other for use in facing boxes for lateral motion. They are both



Driving Box in Position, Showing Universal Jaws and Method of Clamping the Box to the Table

provided with means for rapid traverse by power in any direction, entirely independent of the feed mechanism.

The chucking device, which is shown in one of the illustrations,



42 In. Driving Box Boring Mill

is a complete unit entirely independent from the table, to which it is clamped by a single screw. The chuck has four jaws, two of which are universally operated and two of which are independent.

In setting up a driving box to be finished the cellar bolt lugs are first set against an adjustable stop block fastened to one of the independent jaws. The location of this block determines the amount of stock to be removed from the crown of the brass. On the opposite independent jaw is a second adjustable block, which is made as low as possible in order to facilitate handling the box. By means of this block the box is secured from movement parallel to its vertical center line. The two side jaws are designed to bear against the shoe and wedge faces of the driving box, and by their universal action insure automatic centering of the box between these faces. These jaws have long bearings against the box in order to insure the accurate location of the vertical center line at right angles to the movement of the jaws. When the box has been properly located it is secured to the table by means of clamps included in the construction of the universal jaws. These clamps are adjustable to suit variations in the thickness of driving box flanges.

After the box has been bored the open ends of the crown brass may be backed off without disturbing the location of the box in the chuck. This is accomplished by setting over the entire chuck the required distance upon the face plate. The movement of the chuck is parallel to that of the independent jaws and normal to that of the universal jaws. In setting up work, if desired the box may be chucked with the universal jaws without attention to the location of the independent jaws, and final adjustment for the amount of stock to be removed made by movement of the chuck on the face plate.

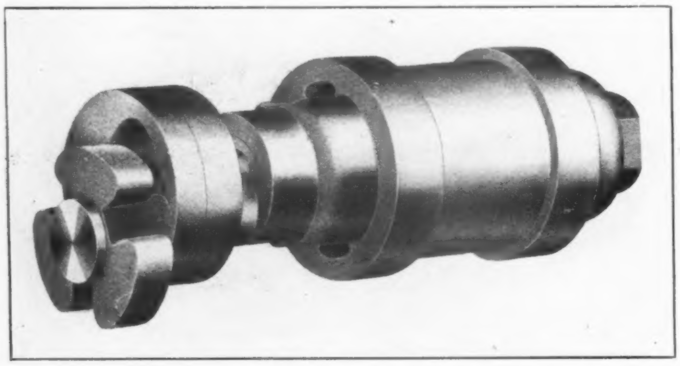
A record of 24 minutes per box, including the time required for setting up and removing from the machine, is claimed to have been made by the use of this chucking device. The box bored was 10½ in. in diameter by 14 in. in length. The stock removed from the crown varying from ¼ in. to ⅝ in. The details of the time record were as follows:

Time required for setting up box to be bored	3 min.
Time required for taking roughing cut	9 min.
Time required for finishing cut	7 min.
Time required for setting box over to be backed off	1 min.
Time required for backing off crown brass	3 min.
Time required for removing box	1 min.
Total time for boring box complete	24 min.

TURBINE BOILER TUBE CLEANER

The illustrations show a turbine boiler tube scale remover for fire tube boilers, which has recently been brought out by the Lagonda Manufacturing Company, Springfield, Ohio. The turbine may be either steam or air driven, and soot, loosened by the knocker, is blown out of the tube ahead of the cleaner by the turbine exhaust.

The knocker head is made of three parts, a cylindrical body



Turbine Fire Tube Cleaner, with Broad Bearing Hammer

somewhat smaller in diameter than the boiler tube, and an eccentrically pivoted lever carrying a clover shaped knocker on a stud at its free end. The lever fits flush in a triangular recess in the forward face of the body, the free end swinging in an arc through the center of the head. The three hammer faces of the knocker are shaped to fit the inner circumference of the boiler tube, thus giving a large area of contact with the tube, and permitting the use of a heavy hammer without injury to the tubes. The force of the blow thus obtained is claimed to successfully loosen very hard and heavy scale.

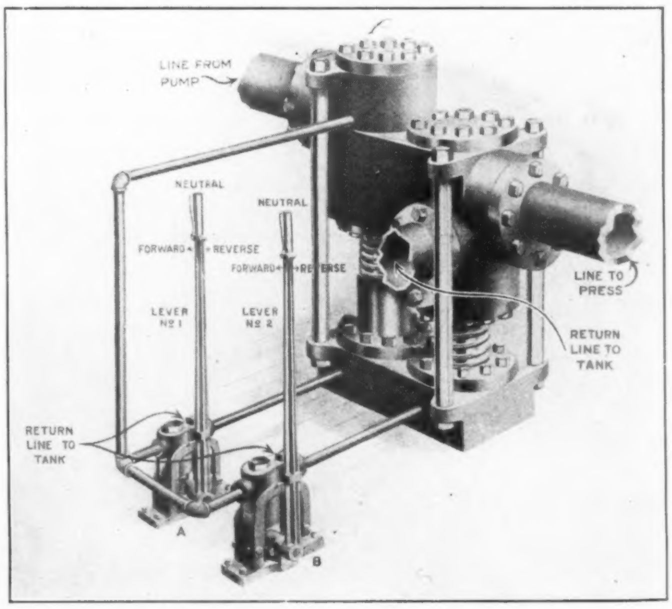
The head is driven at a high rotative speed; the eccentrically pivoted lever carrying the knocker is thrown from side to side and the knocker caused to revolve on its axis at each contact with the tube. The resultant gyratory motion to the knocker causes it to hit all points of the interior circumference of the tube. The cleaner is fed into the tube by the flexible rubber hose supplying the air or steam, the revolving motion of the head eliminating the necessity of turning the cleaner by twisting the hose.

The motor is of the rotary type. The air or steam strikes upon radial paddles, which are continually held out by air or steam pressure admitted to a chamber behind them, so that they always form a tight fit with the case. The motor has four paddles, two of which are always under pressure, making it impossible for the motor to stall. A specially designed automatic oiling device is furnished for the motor.

PILOT OPERATED VALVE FOR HYDRAULIC PRESSES

A direct operating valve which has sufficient capacity for service on hydraulic presses requiring large volumes of water under high pressure, is impracticable because of the difficulty arising in its manipulation. The three-way pilot operated poppet valve shown in the illustrations has been designed for this class of service by the Hydraulic Press Manufacturing Company, Mount Gilead, Ohio.

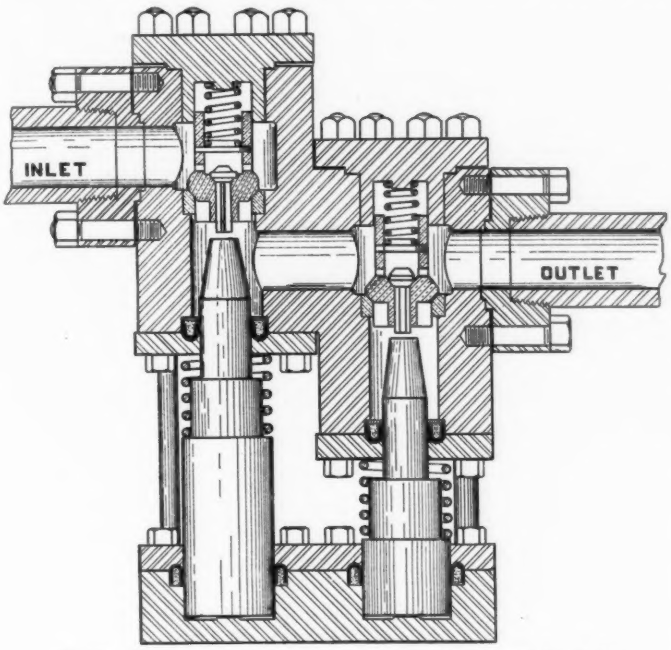
The main valve, a sectional view of which is shown in the



Pilot Operated Poppet Valve for Operating Large Hydraulic Presses

drawing, has three openings and two valves. The valve at the right controls communication between the pump and the press; the other controls communication between the press and the return line to the tank. With both valves open both the pump and the press cylinder are open to the return line, and are therefore both free from pressure. With both valves closed pressure may be retained on both the pump and the press. With the valve to the right open and the other closed, pressure is applied to the press cylinder. With the right-hand valve closed and the other open, pressure is released from the press, but maintained on the pump.

The main valve is operated by means of two small pilot valves shown at A and B, which control the pressure under the rams shown in the sectional elevation. They need not be located near the main valve, but may be placed at the point most convenient for the operator. Each valve has three openings and three positions. The middle position is neutral, all ports being closed. When the valve is in this position, the pressure is held on the



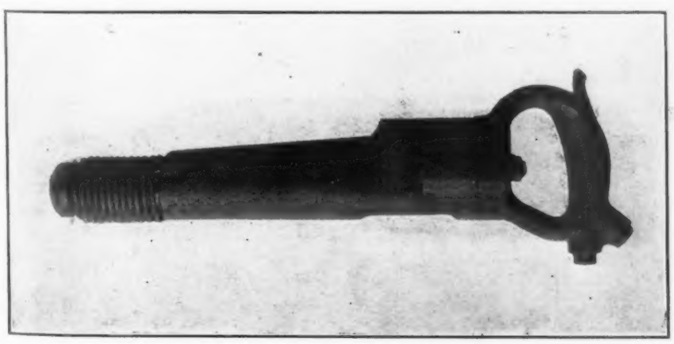
Sectional Elevation, Showing Construction of Main Valve

pressure line and the return line is closed. In the forward position the pressure is applied to the ram, the return line remaining closed. In the reverse position the opening from the pressure line is closed, and the pressure on the ram is released through the return line.

The main valve is designed for pressures of 5,000 lb. per sq. in., or greater. It has a steel body with flanged connections. Special gun metal bronze is used in the construction of the valve seats and checks. The operating cylinders, glands and rams are of cast steel.

PNEUMATIC RIVET SET RETAINER

Several states are drafting safety appliance laws, among the provisions of which are requirements that riveting hammers embody in their construction means to prevent the accidental ejection of the rivet set from the nozzle of the hammer. A



Rivet Set Retainer in Place on Pneumatic Hammer

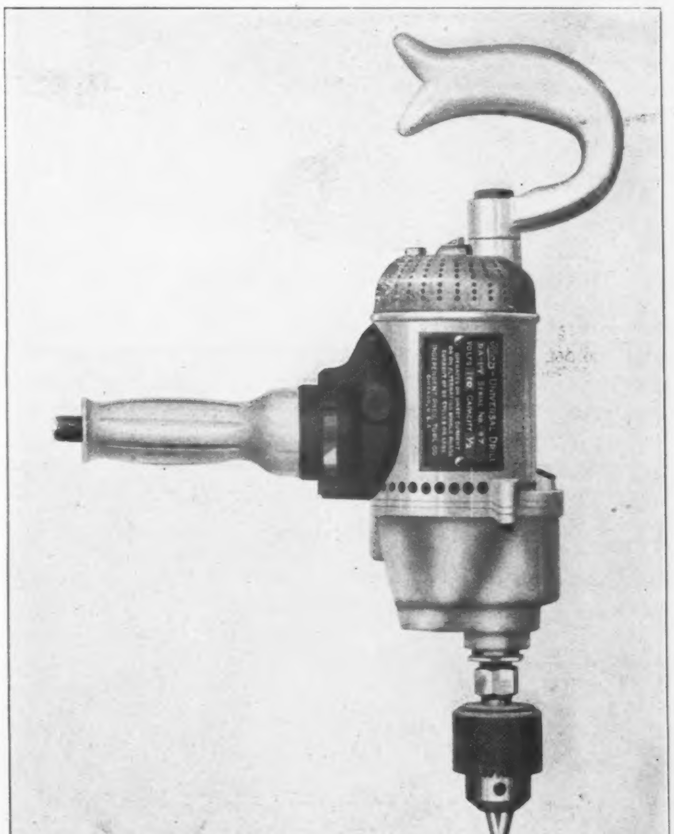
simple device for this purpose is being applied to the riveting hammers manufactured by the Ingersoll-Rand Company, New York.

As shown in the illustration, the retainer consists of a single piece of heavy spring steel, closely wound into a spiral form. One end fits over the outside of the hammer nozzle and hooks over a projection integral with the nozzle. The other end is wound to a small diameter. Sets for rivets over 7/8-in. diameter are formed with a coarse thread and are screwed into place in the retainer. Sets for rivets 7/8-in. diameter and smaller are formed with a shoulder and are slipped into the retainer while it is detached from the hammer, the shoulder holding it in place. The device is claimed to effectively prevent the rivet set or piston from being driven out, even when the hammer is running free. The hammer is provided with a groove in the end of the barrel so that a standard retaining clip may be used, if desired.

PORTABLE ELECTRIC DRILL

A portable electric drill has recently been added to the line of pneumatic tools manufactured by the Independent Pneumatic Tool Company, Chicago.

This drill is equipped with a direct or alternating current motor, being designed to operate on direct current or alternating current of any frequency up to 60 cycles. Both the alternating and direct current motors are of the series winding type and are cooled by drafts of air drawn through the perforated brush cover at the top, past the commutator, between the armature and stator, and exhausted by a fan through a number of holes



Portable Electric Drill with Speed Change Gears

at the bottom of the stator case. The armature is suspended on Hess Bright bearings, the counter shaft and spindle on Hess Bright and roller bearings. The pinion which meshes with an internal gear on the counter shaft is screwed on to the armature shaft, fitting against a taper shoulder which gives absolute rigidity. When worn it may be readily renewed. The switch is of the self-contained contact disc type, having four contact points and breaking both sides of the line simultaneously. This makes the drill absolutely dead when the switch is turned off.

These drills are enclosed in aluminum cases which make

them exceedingly light in weight. They are made in four sizes having ¼ in., 5/16 in., ⅜ in. and 9/16 in. drilling capacities in steel and weighing but 6, 7, 12 and 17 lb., respectively. Each size can be equipped with three different gear ratios giving three different speeds. These speeds are designated by the letters *X* for high, *Y* for medium and *Z* for slow. To obtain these different speeds it is only necessary to exchange two gears for another set. This is done by the removal of the gear case and the nuts which hold the gears on the shafts.

COAL PASSER FOR TENDERS

At the recent convention of the International Railway Fuel Association a paper was presented on adjuncts for locomotive tenders, in which was briefly described the coal passer of the reciprocating type made by Ryan, Galloway & Company, Chicago.

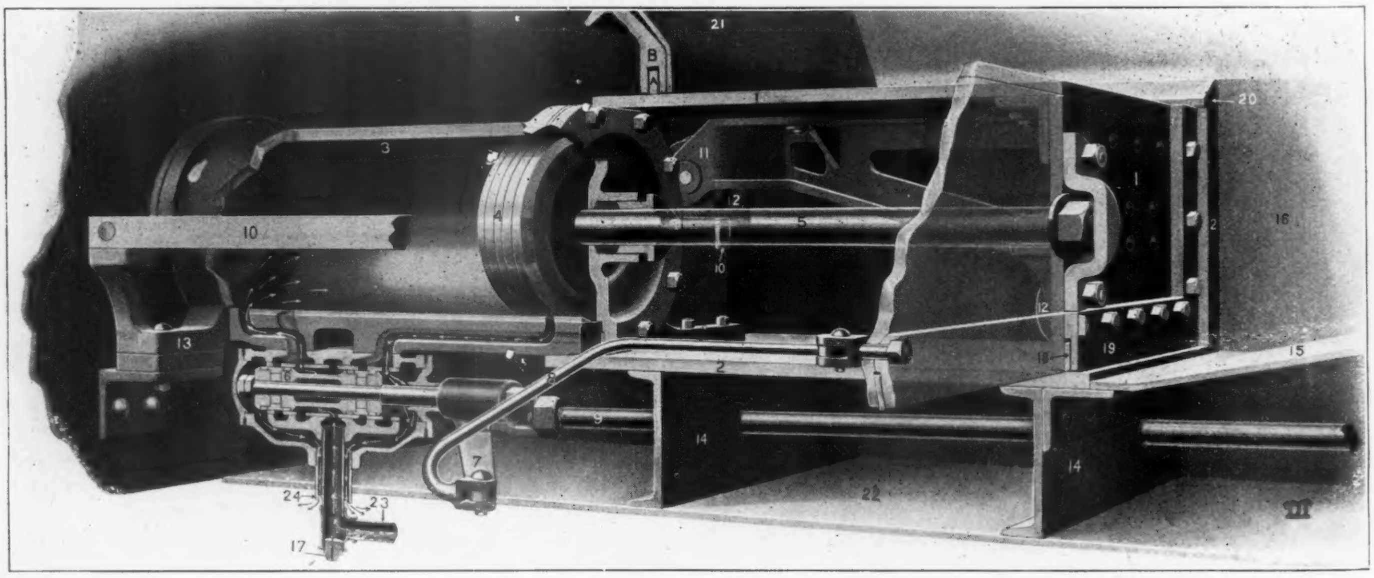
Reciprocating Coal Passer for Locomotive Tenders

Much favorable testimony was offered by members of the association whose roads have been using this type of coal passer, the principal advantages claimed being that it aids the fireman in his work, and permits of his giving better attention to careful firing. It was also stated that in numerous cases it was found possible to decrease the number of coaling stops made on different runs, as the fireman could very conveniently use all of the coal in the tender. This feature is also of an additional advantage in that there is less liability of coal accumulating at the back end of coal space and becoming disintegrated and losing its value on account of being exposed to the weather, as well as affecting the coal pit tank sheets. In many cases it would also eliminate the necessity of two firemen on locomotives, as well as having men shovel the coal forward at points along the line.

The illustrations show the coal passer in detail. It consists of a plunger driven by steam, placed in the bottom and back end of the coal pit, occupying its full width. Its sides are about 15 in. high and are provided with flanges (20) which overhang the top of the plunger so as to prevent any coal being drawn back as the plunger recedes. Steel packing strips (*A* and 18) are also placed at the top and bottom of the plunger respectively for the same reasons. The plunger is supported on the channel iron (14), which rests directly on the floor of the tender. The plunger itself is reinforced by two brackets (11) on each side of the cylinder which contain wheels (12) to provide a roller bearing. The upper rollers operate on the guide rail (10), and the lower rollers on the bottom of the tender. The phantom drawing shows the plunger in its extended position, and it will be noted that the plunger shell extends back over the steam cylinder.

This cylinder is 11 in. in diameter and is operated by steam distributed by the valve shown. The valve is operated by a folding lever placed on the left water leg of the tender convenient to the fireman, who can extend or recede the plunger as desired. The rod (8) and lever (7) are attached to the head of the plunger, as shown, to insure the valve being closed at the end of the stroke, thereby providing a cushion for the piston to work against at the end of each stroke. The steam is admitted through a pipe (23) into the inside admission valve, and the exhaust passes out through a pipe (24), which surrounds the admission pipe so that in cold weather there will be no danger of the exhaust freezing. No. 17 ~~is~~ a vent in the bottom of the steam pipe to permit draining off the condensed steam.

New Steam Engine.—It is said the Rev. W. Morris, minister of Deanrow chapel, Wilmslow, in Cheshire, has invented a new steam engine, expense of erecting which will be less than a tenth part of the cost of a steam engine of equal power, and the expense of working it will be less than one-thousandth part of the expense of working a steam engine of equal power.—*From American Railroad Journal, October* 24, 1835.



Details of Steam Driven Coal Passer of Reciprocating Type

NEWS DEPARTMENT

The new car shops of the Philadelphia & Reading at the coal shipping yard at Pottsville, Pa., have been turned over by the contractors to the railroad company.

The New York, New Haven & Hartford has recently pensioned 13 employees, making 51 altogether retired within three months. George C. Crocker, of Hyamis, Mass., is one of those who have just been pensioned. He is a crossing man who is 82 years old, and has been in the service nearly 60 years.

Two giant cacti, the largest ever moved from the desert, have been taken from Arizona by the Atchison, Topeka & Santa Fe to San Francisco, and have been placed at the entrance to the Hopi Indian village, which forms a part of the $350,000 reproduction of the Grand canyon of Arizona, being erected on the Panama-Pacific Exposition grounds by the Santa Fe. One of the cacti stands 23 ft. high and weighs 4,500 lb. The removal cost $1,000 for each cactus.

The Cape Cod Canal, connecting Buzzard's Bay with Cape Cod Bay and shortening by 70 miles the water route between New York and Boston, was opened to commerce July 29, but with only 15 ft. of water, about 10 ft. less depth than will be finally provided. The dedication ceremonies took place at the village of Buzzard's Bay and were witnessed by thousands. Seth Low, president of the Chamber of Commerce of the state of New York, presided. The speakers included August Belmont, president of the canal company; Assistant Secretary of the Navy Roosevelt; Governor Walsh of Massachusetts, and Congressman Thomas C. Thacher, the representative from the Cape district.

Officers of the shop craft unions which struck on the Illinois Central and Harriman lines in 1911 are gathering a large amount of evidence, in connection with the strike, with a view to presenting it to the United States commission on industrial relations. The committee says it is the intention to show that this was not a strike but a "lockout," resulting from the refusal of the roads to recognize their federation. An effort is being made to locate all of the men who struck, and question blanks are being sent out to ascertain how many have lost homes on account of inability to make payments, whether children have been obliged to go to work, whether any of the strikers or members of their families have committed suicide, and other matters of a similar nature.

The New York State Workmen's Compensation Commission reports that the railroads are no longer opposing the application of the workmen's compensation law. They are insuring their risks, some having taken out policies in the state fund while others have given their business to the stock insurance companies. Still others insure their own risks. The distinction between intrastate and interstate employees in applying the law to the railroads is still an unsettled question, and decision in the matter probably will be held in abeyance until the first claims are filed. Four hundred claims for compensation had been filed up to July 8. It was found that only four of these were death claims.

In 1856 the Lehigh Valley had the following rule in effect: "Always leave Mauch Chunk and Easton on time if possible. In case of wet rail or bad track, the morning trains from Easton may leave enough ahead of schedule time to arrive at Bethlehem [eleven miles] before the down passenger train arrives. Run as near schedule time as possible and in no case allow your engineer to run into a station more than five minutes ahead of time, except at stations where you get your meals, or where you take fuel and water."

BRITISH RAILROAD ACCIDENTS IN 1913

The number of persons killed in train accidents in Great Britain and Ireland in the calendar year 1913 was 41 and of injured, 871, as follows: Passengers, 33 killed, 723 injured; employees, 8 killed, 145 injured; other persons, none killed, three injured. Of passengers the increase over 1912 in the number killed is 13, and of employees, the increase is 2. The average annual number of passengers killed in train accidents in the years 1902-1911 was 19 and of employees, 9.

Including accidents of all kinds connected with the movement of trains and the conduct of business at the stations, the number of persons killed in 1913 was 1,131 and of injured, 9,054, increases of 120 and of 355 over the totals for 1912. Accidents not connected with the movement of cars or locomotives, are reported in a separate statement; these amount to 63 persons killed and 24,742 injured; so that the total of "railroad casualties" in the most inclusive sense was 1,194 killed and 33,796 injured.

NEW HIGH RECORD TRAIN LOAD

The Erie's Triplex type locomotive, recently put in service for use as a pusher on Susquehanna Hill was given a hauling capacity test on the Susquehanna division July 23, in which all previous records for train loads, hauled by one locomotive, were broken and a new record established which bids fair to stand unequalled for some time to come.

The test was made from Binghamton, N. Y., to Susquehanna, Pa., a distance of about 23 miles. The train consisted of 250 fifty-ton steel gondolas, each loaded to capacity, and a dynamometer car, and weighed 17,912 tons, exclusive of the locomotive. Its total length was 8,547 ft., or 1.6 miles. The grade between the two stations is gradually ascending, the worst condition being a combination of .09 per cent grade and 5 deg. curvature.

Pushers were used to assist in getting the train under way. They pushed the slack forward until the Triplex lead locomotive had all the cars moving, after which they were uncoupled and followed the train in case they should be needed again. This operation eliminated the danger of pulling out drawheads in starting, which otherwise would undoubtedly have occurred with a train of such length. Portable telephones were used to communicate from the head end to the rear of the train, and this made it possible for the pushers to do their work in unison with the lead engine in starting the train. A summary of this record breaking haul is given below:

Number of cars in train	251
Total weight of train (excluding locomotive)	17,912 tons
Total length of train	1.6 miles
Maximum speed attained	14 miles per hr.
Maximum drawbar pull	130,000 lb.
Minimum drawbar pull	67,000 lb.

A complete illustrated description of this locomotive was published in our issue of May, 1914, page 227. It is probable that exhaustive tests will be made in pushing service on the Susquehanna hill.

EXTENSIVE UNDERSTUDYING ON THE BALTIMORE & OHIO

To broaden the knowledge of its division officers and give them the benefit of a thorough training with respect to the methods of administering the affairs of the company in the general offices at Baltimore, the Baltimore & Ohio is putting its division officers through a course of employment which will

better equip them for promotion to positions of greater responsibility. Assistant superintendents, trainmasters and, in some instances, their subordinates, are transferred to Baltimore and set at work where they can study the problems of operation from the viewpoint of the general officers. While the staff officials are thus engaged their subordinates discharge the regular duties of the office. The plan, therefore, has the added advantage of equipping the men lower in rank to qualify when vacancies occur.

The men who take the course in the general offices are employed for a period in the transportation department; then in maintenance of way work, in the motive power office, the accounting and statistical departments, and in the tonnage, discipline, employment, station service, rates of pay and other bureaus, so that when they return to their respective divisions it will be with a general knowledge of the relation of their work to the operation of the property as a whole. Several of these men are in the Baltimore offices constantly, and when they go back to their regular duties others are brought in.

RAILWAY MAIL PAY

In reference to the publication of a report from Washington that the House Committee on Post Offices had taken action designed to increase the allowance made railways for the transportation of the mails, Ralph Peters, chairman of the Committee on Railway Mail Pay, authorized the following statement:

"The bill introduced by Congressman Moon had proposed to reduce the railway mail pay at least $3,000,000 below what had already been appropriated for this fiscal year. The amendment apparently made to the Moon bill merely provides for the restoration of substantially the $3,000,000 by which it had been proposed to cut the pay.

"The railroads have contended and they still insist that they are already underpaid at least $15,000,000 a year. Congress now has at work a bi-partisan commission investigating the question of fact as to whether the railroads are or are not underpaid for this service. It is obviously impossible to properly consider a readjustment until the question of fact has been established.

"The railroad committee believes, therefore, that in justice to the railroads and in justice to the public the report of the joint Congressional commission should be awaited. The railroads are confident that that report will submit a finding on the main question of fact, which will be fair to all concerned.

"When that report is submitted and the question of fact is determined, the railroads' committee will be prepared to cooperate with the government in developing a method of readjusting the underpayments or overpayments in such a manner that the interests of all may be properly protected."

MEETINGS AND CONVENTIONS

Chief Interchange Car Inspectors' and Car Foremen's Association.—The annual meeting of this association, which promises to be of more than ordinary interest, will be held at the Hotel Sinton, Cincinnati, Ohio, August 25-27. The secretary is S. Skidmore, 946 Richmond street, Cincinnati, Ohio.

American Boiler Manufacturers' Association.—The American Boiler Manufacturers' Association will hold its twenty-sixth annual convention at the Waldorf-Astoria, in New York, from September 1 to 4. An invitation to attend has been extended to all boiler, tank and stack manufacturers, fabricators of steel plate and representatives of supply companies.

Master Car and Locomotive Painters' Association.—The forty-fifth annual convention of the Master Car and Locomotive Painters' Association will be held in Nashville, Tenn., September 8 to 11, inclusive, at the Hotel Hermitage. The subjects to be considered are: Finishing Steel Passenger Equipment; Rust Inhibitive Paint for Steel Freight Cars; Shop Practice in Finishing New Interior Wood Finish of Passenger Coaches; Locomotive Tender Varnishes; Classification of Interior and Exterior Repairs of Passenger Cars; Apprentice System in the Paint Shop; Results of the Sand Blast as a Paint Remover; Standard Freight Car Lettering, and Blister-proof Paint for Locomotives. A. P. Dane, Reading, Mass., is secretary.

American Foundrymen's Association and American Institute of Metals.—The American Foundrymen's Association and the American Institute of Metals will meet in Chicago, September 7 to 11, inclusive, at the La Salle hotel. In connection with this convention there will be a large exhibit at the International Amphitheater, located at the stock yards in Chicago. This should prove of considerable interest to railway men, as a large amount of machine shop equipment will be exhibited. Last year there were 178 exhibitors, 40 of which handled machine shop equipment exclusively. It is, in fact, one of the largest machine tool exhibits held in this country. In addition, there will be a number of oxy-acetylene welding companies represented with working demonstrations as well as electric welding companies, and the Goldschmidt Thermit Company. Railroad men who have the opportunity to visit this exhibit will find it very instructive and much to their advantage.

International Railroad Master Blacksmiths' Association.—The twenty-second annual convention will be held at the Hotel Wisconsin, Milwaukee, Wis., August 18, 19 and 20, 1914. The following are the subjects to be considered: "Flue Welding," Wm. T. F. Duggan, chairman; "Making and Repairing Frogs and Crossings," W. F. Stanton, chairman; "Carbon and High Speed Steel," G. F. Hinkins, chairman; "Tools and Formers," Wm. H. G. Sharpley, chairman; "Electric Welding," T. F. Keene, chairman; "Drop Forging," Ed. Dixon, chairman; "Spring Making and Repairing," Hugh Timmons, chairman; "Piece Work and Other Methods," J. E. Dugan, chairman; "Locomotive Frame Making and Repairing," George Hutton, chairman; "Oxy-Acetylene Process for Cutting and Welding Metals," T. E. Williams, chairman; "Case Hardening," P. T. Lavender, chairman; "New Subjects," J. R. Russell, chairman; "Heat Treatment of Metals," John F. Keller, chairman; "Shop Kinks," W. C. Scofield, chairman.

The following list gives names of secretaries, dates of next or regular meetings, and places of meeting of mechanical associations.

AIR BRAKE ASSOCIATION.—F. M. Nellis, 53 State St., Boston, Mass. Convention, May 5-7, 1915, Hotel Sherman, Chicago.

AMERICAN RAILWAY MASTER MECHANICS' ASSOC.—J. W. Taylor, Karpen building, Chicago.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—Owen D. Kinsey, Illinois Central, Chicago. Convention, July, 1915, Chicago.

AMERICAN SOCIETY FOR TESTING MATERIALS.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Convention, December 1-4, 1914, New York.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 841 North Fiftieth Court, Chicago; 2d Monday in month, except July and August, Lytton building, Chicago.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—S. Skidmore, 946 Richmond street, Cincinnati, Ohio. Convention, August 25-27, 1914, Cincinnati, Ohio.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—C. G. Hall, 922 McCormick building, Chicago. Convention, May 17-20, 1915, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 914 W. Broadway, Winona, Minn. Convention, July, 1915.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—A. L. Woodworth, Lima, Ohio. Convention, August 18-20, 1914, Milwaukee, Wis.

MASTER BOILER MAKERS' ASSOCIATION.—Harry D. Vought, 95 Liberty St., New York.

MASTER CAR BUILDERS' ASSOCIATION.—J. W. Taylor, Karpen building, Chicago.

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOC. OF U. S. AND CANADA.—A. P. Dane, B. & M., Reading, Mass. Convention, September 8-11, 1914, Nashville, Tenn.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—E. Frankenberger, 623 Brisbane building, Buffalo, N. Y. Meetings monthly.

RAILWAY STOREKEEPERS' ASSOCIATION.—J. P. Murphy, Box C, Collinwood, Ohio.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, N. Y. C. & H. R., East Buffalo, N. Y. Convention, September 15, 16, 17 and 18, 1914, Hotel Sherman, Chicago, Ill.

Personals

It is our desire to make these columns cover as completely as possible all the changes that take place in the mechanical departments of the railways of this country, and we shall greatly appreciate any assistance that our readers may give us in helping to bring this about.

GENERAL

J. Hainen, superintendent of motive power of the Southern Railway at Washington, D. C., has been promoted to general superintendent of motive power and equipment, with headquarters at Washington, succeeding A. Stewart, deceased.

Alonzo G. Kinyon has been appointed superintendent of locomotive operation of the Seaboard Air Line. Mr. Kinyon was born at Amboy, Ill., on July 12, 1867. He entered railway service in 1888 as a fireman on the Chicago, Milwaukee & St. Paul, later becoming an engineman. A few months before he left the servin 1901 he entered the railway department of the International Correspondence Schools, and was respectively compound locomotive instructor, air brake instructor, and combustion and fuel economy instructor. He resigned in 1905 to engage in other business, but in 1906 returned to railway work as road foreman of engines on the Southern Railway, where he remained until June 1, 1907. In November, 1910, he was appointed special instructor on fuel economy of the Buffalo, Rochester & Pittsburgh, but left about one year later to become superintendent of combustion and fuel economy instruction with the International Correspondence Schools. On March 1, 1911, Mr. Kinyon entered the railway supply field as chief traveling engineer of the Hanna Locomotive Stoker Company, Cincinnati, Ohio. On April 1, 1912, he left to accept a similar position with the Westinghouse Air Brake Company in connection with the Street stoker, and about one year later he became locomotive fuel engineer of the Clinchfield Fuel Company, Spartanburg, S. C., with which company he remained until his recent appointment, as above noted.

C. T. Ripley has been appointed general mechanical inspector of the Atchison, Topeka & Santa Fe, succeeding J. L. Armstrong, promoted.

E. C. Sasser has been appointed superintendent of motive power of the Northern and Eastern districts of the Southern Railway, with headquarters at Washington, D. C.. Mr. Sasser was born on November 16, 1875, in Wake county, N. C., and was educated at Holden Academy, Raleigh. He began railway work at the age of 16 in the shops of the Raleigh & Gaston, now a part of the Seaboard Air Line, as machinists' apprentice at Raleigh, and at the completion of his apprenticeship entered the service of the Southern Railway at Alexandria, Va., and was then consecutively machinist, machine shop foreman and general foreman. In 1898 he returned to Raleigh and entered the service of the Lobdell Car Wheel Manufacturing Company. The following year he went to the Seaboard Air Line at Raleigh, leaving that company in May, 1901, to become superintendent of the Acme Machine Works, Goldsboro, N. C. He went to the Southern Railway in May, 1902, as erecting shop foreman at Columbia, S. C., and was promoted to general foreman in August of the same year. The following October he left that company to enter the service of the American Locomotive Company at the Richmond branch as equipment inspector. The following year he was promoted to general machine shop foreman, and in March, 1905, left that company to return to the service of the Southern Railway as shop superintendent. He was promoted to master mechanic of the Charleston shops in May, 1908, and in October of the following year was transferred in the same capacity to the Alexandria shops. He was again transferred in May, 1910, as master mechanic of the Spencer, N. C., shops, which position he held at the time of his recent appointment as superintendent of motive power of the same road, as above noted.


E. C. Sasser

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

Hugh Gallagher, master mechanic of the Atchison, Topeka & Santa Fe at La Junta, Col., has resigned.

D. Hickey, master mechanic of the Southern Pacific at Sparks, Nev., has been transferred to Ogden, Utah.

CAR DEPARTMENT

T. D. LaMasters has been appointed general car foreman of the Southern Pacific at Ogden, Utah.

E. A. Sweeley has been appointed master car builder of the Seaboard Air Line at Portsmouth, Va. He will have jurisdiction over the entire car department.

SHOP AND ENGINE HOUSE

J. L. Armstrong has been appointed general foreman of the Atchison, Topeka & Santa Fe at Corwith, Ill., succeeding W. J. Eddington, deceased.

C. H. Baynham has been appointed locomotive foreman of the Canadian Pacific at Swift Current, Sask., succeeding A. J. Pentland, transferred.

F. W. Bentley, Jr., has been appointed air brake foreman of the Chicago & North Western at Missouri Valley, Ia.

F. A. Boswell has been appointed locomotive foreman of the Canadian Pacific at Moose Jaw, Sask., succeeding C. H. Baynham, transferred.

L. W. Hendricks has been appointed roundhouse foreman of the Mahoning Division of the Erie at Brier Hill, Ohio, succeeding C. W. Shane, resigned.

M. Miller has been appointed locomotive foreman of the Canadian Pacific at Ottawa, Ont., succeeding R. H. McDonald.

R. Sproule has been appointed day shop foreman of the Canadian Pacific at Winnipeg, Man., succeeding F. Johnson, promoted.

PURCHASING AND STOREKEEPING

C. D. Baldwin, purchasing agent of the Bangor & Aroostook at Milo Junction, Me., has moved his office to Derby.

A. A. Dawley has been appointed purchasing agent of the Denver & Salt Lake at Denver, Colo.

E. L. Fries has been appointed general storekeeper of the Union Pacific at Omaha, Neb., succeeding J. H. Stafford, retired under the pension rules of the company.

Ira Neiswinter has been appointed division storekeeper of the Atchison, Topeka & Santa Fe at Emporia, Kan.

G. W. Saul, assistant purchasing agent of the Oregon-Washington Railroad & Navigation Company, has been appointed purchasing agent at Portland, Ore., succeeding R. Koehler, retired.

G. E. Scott, acting purchasing agent of the Missouri, Kansas & Texas, has been appointed purchasing agent, with headquarters at St. Louis, Mo.

ERNEST BAXTER, whose appointment as purchasing agent of the St. Louis Southwestern at St. Louis, Mo., was announced in the July issue, was born October 11, 1882, at Delmer, Ont. He received a public and high school education, and began railway work in March, 1903, as messenger in the local freight office of the Michigan Central. From May to September he was with the Algoma Central & Hudson Bay as a clerk at Sault Ste. Marie, Ont., and from October, 1903, to March, 1905, he was secretary to the superintendent of the Grand Trunk at London, Ont. Mr. Baxter was then employed successively in the operating departments of the Cincinnati, Hamilton & Dayton at Indianapolis, Ind., and the Missouri Pacific at St. Louis, Mo., until February, 1906, when he became secretary to the general manager of the St. Louis Southwestern at St. Louis. In May, 1909, he was made chief clerk to the president of the latter road, from which position he was promoted to that of purchasing agent on June 22, as above noted.

E. Baxter

HENRY ORVILLE HUKILL, purchasing agent of the Pennsylvania Lines West of Pittsburgh, with headquarters at Pittsburgh, Pa., who retired on June 1, under the pension rules of the company, was born on May 25, 1844, at Steubenville, Ohio, and was educated in the public schools of his native town. At the age of 16 he entered the service of the Steubenville & Indiana, now a part of the Pittsburgh, Cincinnati, Chicago & St. Louis, as a messenger in the superintendent's office. In 1863, he was appointed an assistant operator, and in April of the following year entered the service of the Pittsburgh, Fort Wayne & Chicago and the Cleveland & Pittsburgh, now part of the Pennsylvania Lines West of Pittsburgh, as telegraph operator and clerk in the office of the purchasing agent at Pittsburgh. He was promoted on January 1, 1877, to chief clerk to the purchasing agent, and ten years later was appointed assistant to purchasing agent. He remained in this position until January 1, 1894, when he was appointed purchasing agent of the Pennsylvania Lines West, from which position he now retires after a service of over 54 years on the Pennsylvania Lines. At the time of the retirement of Mr. Hukill, the directors of the Pennsylvania Company adopted the following minute: Mr. Hukill's long service in the purchasing department was noted for the sound judgment and business principles which governed him in all his official relations. The contracts made by him for materials and supplies aggregated enormous sums of money, but his constant study of market conditions and his knowledge of values enabled him to make these purchases under terms that were advantageous to the company, and at the same time fair to the manufacturers. The integrity of his character and the genial and winning nature of his personality won the esteem and friendship of his associates, and the board of directors takes great pleasure in expressing its appreciation of his able and faithful service and wishes for him many years of happiness and health.

H. O. Hukill

T. D. SINGLETARY has been appointed storekeeper of the Macon, Dublin & Savannah at Macon, Ga., succeeding G. S. Pratt, resigned.

RAY F. TRANSUE has been appointed storekeeper of the Lehigh & New England at Pen Argyle, Pa., succeeding F. B. Arndt, resigned.

OBITUARY

DANIEL J. MALONE, superintendent of shops, of the Oregon Short Line, at Pocatello, Idaho, was shot and killed, July 24, by Frank Madden, foreman of the tin shop. The murderer, with the same revolver, at once killed himself. The men were both old employees and had long been friends, but Madden, it is believed, had became mentally unbalanced because of criticisms received on account of unsatisfactory work. Mr. Malone was born at Western Point, Md., in 1860, and he was on the Union Pacific for a number of years before going to the Oregon Short Line in 1890. Madden was 60 years old. Malone had four brothers, two of whom met death in murders very much like this one; Edward in West Virginia in 1896, and Michael, division foreman on the Southern Pacific, in Nevada, in 1906.

SAMUEL F. PRINCE, JR., formerly superintendent of motive power and rolling equipment of the Philadelphia & Reading, died in New York City on July 13, from the effects of a bullet wound. Mr. Prince was born 62 years ago and previous to January, 1892, was mechanical engineer of the Philadelphia & Reading, and then to the following March was assistant consulting engineer of the Long Island. He was appointed superintendent of motive power in March, 1892, and from February, 1893, to August, 1899, was superintendent of motive power and equipment of the same road. On August 1, 1899, he was appointed superintendent of motive power and rolling equipment of the Philadelphia & Reading, and left that company in June, 1904, to enter the service of the Niles-Bement-Pond Company, at New York. He retired some years ago from active service on account of ill health.

NEW SHOPS

ATLANTIC COAST LINE.—A contract is reported let to D. J. Rose, Rocky Mount, N. C., for improvements at Florence, S. C., to include a roundhouse, a turntable, planing mill and machine shop.

CHICAGO & NORTH WESTERN.—This company is contemplating building a 180-car capacity repair yard at Clinton, Iowa. There will be a total of four buildings, one brick veneer mill building, 60 by 150 ft., one brick veneer shop building, 50 by 100 ft., one frame store building, 22 by 150 ft., and one frame lumber shed 22 by 100 ft. The estimated cost is about $80,000.

ILLINOIS CENTRAL.—This company is planning to lay out a small yard and to construct shops at Dyersburg, Tenn., the total costing about $150,000.

NORTHERN PACIFIC.—A roundhouse and locomotive plant, consisting of a 33-stall roundhouse, a machine shop with 7 repair pits, a tank and paint shop with 5 repair pits, a turntable, coal docks and a three-story brick storehouse will be erected near the Union depot at St. Paul. Estimated cost, $500,000.

SUPPLY TRADE NOTES

The Railway & Traction Supply Company has moved its office from room 1307 to larger quarters in room 504, Rector building, Chicago.

W. G. Willcoxson has been appointed representative in the railway department of the Garratt-Callahan Company, with office at 27 South Clinton street, Chicago, Ill.

The American Flexible Bolt Company, Pittsburgh, Pa., has opened offices at 50 Church street, New York, with R. W. Benson in charge as general sales manager.

H. W. Green, for the past ten years district sales agent for the American Steel Foundries in Pittsburgh, has been elected vice-president of the Lawrence Steel Casting Company, Pittsbugh, Pa.

Charles R. Crane will retire shortly as president of the Crane Company, Chicago, to be succeeded by R. T. Crane, Jr., now first vice-president, and R. T. Crane, 3rd, will be advanced from second vice-president to first vice-president.

John W. Dix has been appointed assistant general sales manager and structural engineer of the Carnegie Steel Company, Pittsburgh, Pa., succeeding John C. Neale, who has resigned to become president and general manager of the Central Steel Company, Massillon, Ohio.

Stephen C. Mason, secretary of the McConway & Torley Company, Pittsburgh, Pa., has accepted appointment as an executive member of the Railway Business Association. William McConway, president of the same company, recently retired as an executive member of the association.

Harry C. Holloway, who was for several years representative of the Rail Joint Company, New York, resigned on July 1 and opened an office in the Railway Exchange, Chicago. He will handle railway supply accounts, representing among other companies the Keystone Grinder & Manufacturing Company, of Pittsburgh.

The American Car Roof Company, Chicago, manufacturer of the Christy steel freight car roof, has changed its method of business and now gives the right to build the Christy roof on cars to the car builders themselves on a royalty basis. This arrangement makes it possible to equip a car with this particular roof, in the same shop that the car itself is being built.

Mudge & Co., Chicago, are now manufacturing and selling their own passenger car ventilator which is known by the trade name "Mudge-Peerless." This company is now representing in western territory the Chambers Valve Company of New York. The Chambers throttle valve now being exclusively manufactured by the latter company was recently acquired from the Watson-Stillman Company.

The Railroad Valuation Company has recently been organized, with offices at 25 Broad street, New York, with a staff of engineers, analysts and accountants of wide experience in valuation work for the purpose of preparing maps and other data for railroads who have to submit such data in the federal valuation and may not otherwise have the advantage of a special staff for this work.

Ralph W. Perry, chemist and engineer of tests for the Michigan Central during the construction of the Detroit river tunnel and the improved terminal facilities at Detroit, has severed his connection with the company and has leased its laboratory at Fifth street and River Front, Detroit, renaming it the Perry Testing Laboratory, with the idea of conducting a general chemical, inspecting and testing business.

Joseph T. Ryerson & Son, Chicago, have taken over the plant, merchandise, equipment and good will of the W. G. Hagar Iron Company, St. Louis, Mo. It is the intention of the company to supplement the plant of the latter with complete modern warehouses and equipment for the handling and cutting of shapes, reinforcing bars and similar heavy material. Ryerson & Son will thus be able to render immediate service in their lines of finished steel to customers in the territory tributary to St. Louis.

On June 19, the United States patent office issued to William R. McKeen, president of the McKeen Motor Car Company, Omaha, Neb., patent No. 352,725, covering all-steel box cars, including underframe, superstructure, the steel box, the steel bracing and the diagonal bracing. This patent has been in litigation since 1906 in two interference cases which have been passed on by the examiners in chief, the commissioner of patents and the court of appeals of the District of Columbia, sustaining practically every claim made by Mr. McKeen. The Union Pacific steel box cars built in 1906 and 1907 were built under this patent.

C. W. Cross has been appointed Chicago representative of the Equipment Improvement Company, New York. Mr. Cross began his railroad experience with the Pennsylvania Lines West and left that system when assistant master mechanic at Fort Wayne to become master mechanic of the Lake Shore & Michigan Southern, with headquarters at Elkhart, Ind. He was made superintendent of apprentices of the New York Central Lines in 1906 when that system revised and centralized its apprenticeship department to meet modern conditions. Mr. Cross' work in the development of this department is widely known and requires no comment.

Judge Hazel in the U. S. District Court at Buffalo has upheld the directors and majority stockholders of the United States Light & Heating Company, Niagara Falls, N. Y., in the receivership of that corporation by ordering the answer of Henry A. Ackerman stricken out and vacating the appointment of receivers in the action which was brought by the Picher Lead Company. Simultaneously, he appointed James O. Moore, of Buffalo, and James A. Roberts, of New York, receivers in a new action brought by the Central Trust Company of New York, which holds $200,000 of the company's notes. The Central Trust Company is not antagonistic to the existing control of the United States Light & Heating Company. The plaintiffs in the other receivership proceeding, Henry A. Ackerman and G. M. Walker, who were appointed receivers at the outset of the Picher Lead Company's action, were removed a few days ago.

THE SMOKE NUISANCE IN 1835.—For a method of building chimneys that will not smoke, contract the space immediately over the fire so you may be sure of the air being well heated there; this will ensure a current upwards. All chimneys should be carefully built, and every joint well filled with mortar, so as to prevent communication in case of fire. (Dr. T. Cooper.)—*From American Railroad Journal, August* 22, 1835.

USE OF SILVER IN MOVING PICTURE FILMS.—The largest single use for silver, outside of the manufacture of silver-plated ware, is in the manufacture of photographic plates, films, and paper. The manufacture of films for moving picture use has now become an enormous business, and it is probable that in the future this will bring the largest consumption of silver. The silver is used in photography for making the light-sensitive emulsion and is principally the bromide of silver.—*The Engineer.*

TROY AND BALLSTON RAILROAD.—We learn, by the Ballston Gazette, the railroad from the city of Troy to that village is so far completed, that the new engine with a train of passenger cars will arrive there on Thursday or Friday from Waterford. Thus it is that one railroad after another is brought into use; and it will not be many years before the mode of traveling on all the great thoroughfares will be by railroad and steamboat.—*From the American Railroad Journal, August* 15, 1835.

CATALOGS

JACKS.—Catalog No. 102 of the Duff Manufacturing Company, Pittsburgh, Pa., contains 143 pages, and is devoted to the various types of jacks manufactured by this company. It is profusely illustrated.

FORGING MACHINE.—National Forging Machine Talk No. 4 has been issued by the National Machinery Company, Tiffin, Ohio. This is illustrated and deals with the effect of big die opening on the economy of forging machines.

COAL PICKS.—Circular No. 67 from the National Malleable Castings Company, Cleveland, Ohio, describes the malleable iron coal picks for locomotive tenders manufactured by this company. Two different types are dealt with in the leaflet.

STEEL TAPED CABLE.—The Simplex Wire & Cable Company, 201 Devonshire street, Boston, has issued a catalog dealing with the Simplex steel taped cable. It is claimed that this cable can be used underground where a conduit system is too expensive.

HOSE COUPLING.—A four page circular from the Gold Car Heating & Lighting Company, Whitehall building, New York, describes their No. 804-S steam hose coupler. The special features of this coupler are a gravity safety trap and an oscillating gasket.

SIDE HEAD BORING MILL.—The Pratt & Whitney Company, Hartford, Conn., has issued a catalog dealing with the side head boring mills manufactured by this company. A large number of very clear illustrations are included as well as descriptive matter.

HYDRAULIC PRESSES.—Catalog No. 40 from the Hydraulic Press Manufacturing Company, Mount Gilead, Ohio, contains 128 pages, and includes descriptive matter and illustrations of the various lines of hydraulic presses and accumulators manufactured by this company.

LOCOMOTIVE VALVE GEAR.—A 39 page booklet recently issued by the Pilliod Company is devoted to illustrations of locomotives to which the Baker valve gear has been applied. It also contains information relative to the number of engines which have been equipped.

HAMMERS.—A 64 page catalog has been issued by the David Maydole Hammer Company, Norwich, N. Y. This catalog contains illustrations of hammers for a great variety of uses with specifications and complete indexes in English, French, German and Spanish.

FLEXIBLE STAYBOLTS.—The Flannery Bolt Company, Pittsburgh, Pa., has issued the 1914 catalog of the Tate flexible staybolt and tools for its installation. This book is very completely illustrated and will be found of great value wherever these bolts are used.

HEAT TREATING FURNACES.—Tate, Jones & Company, Inc., Pittsburgh, Pa., has issued a 32-page catalog illustrating and describing their line of heat treating furnaces. These furnaces are for annealing, hardening and tempering steel and for all heat treating operations.

CRANES.—Catalog No. 110 superseding No. 82 has just been received from the Whiting Foundry Equipment Company, Harvey, Ill. It contains 48 pages illustrating and briefly describing the various types of cranes manufactured by this company, and will be sent free upon request.

DETACHABLE LINK BELT.—Advance section A of general catalog No. 110 from the Link-Belt Company, Chicago, is devoted to the Ewart detachable sprocket wheels. It contains 112 pages and gives a large number of illustrations and much information pertaining to this apparatus.

ELECTRIC FIXTURES.—The Safety Car Heating & Lighting Company, 2 Rector street, New York, has recently issued a 95-page catalog of electric lighting fixtures for car lighting. This catalog is very nicely gotten up and includes illustrations of a wide variety of fixtures for all sizes of work.

SERPENTINE SHEAR.—The Lennox serpentine shear is dealt with in bulletin No. 1371, issued by Joseph T. Ryerson & Son, Chicago. This machine is intended for straight and irregular cutting of sheets and plates, and can be furnished in different sizes varying in capacity from No. 16 gage to ¼ in.

OXY-ACETYLENE WELDING AND CUTTING.—The Macleod Company, 213 East Pearl street, Cincinnati, Ohio, has issued a 40-page catalog dealing with the Buckeye Oxy-acetylene welding and cutting outfits. The catalog contains illustrations and data pertaining to the different sizes and types of this equipment

INSERTED TOOTH MILLING CUTTERS.—Bulletin No. 6 of the Tindel-Morris Company, Eddystone, Pa., is devoted to the Tindel inserted tooth milling cutter. These milling cutters are intended for any class of milling work and simplicity of design, durability and ease of maintenance are among the points claimed for them.

BRAKE RODS.—An eight page booklet issued by the Schaefer Equipment Company, Oliver building, Pittsburgh, Pa., describes the solid forged truck lever connections manufactured by this company. These rods are formed without welds, from heavy steel plates, the ends being drop forged to form reinforced holes and jaws.

BALL BEARINGS.—The S. K. F. Ball Bearing Company, 50 Church street, New York, has issued bulletin No. 16-3M dealing with the application of their product to electric motors. It contains 37 pages, and includes a large number of illustrations showing the application of S. K. F. ball bearings to various types of motors.

DRILLS.—The July number of Drill Chips, issued by the Cleveland Twist Drill Company, Cleveland, Ohio, is devoted to an interesting account of the processes followed in the manufacture of drills from the time stock is received at the works until the drills are ready for shipment. It contains 16 pages and is well illustrated.

FRICTION SAW.—Bulletin No. 9,071, issued by Joseph T. Ryerson & Son, Chicago, describe the Ryerson high-speed friction saw. This machine is for use in railroad car, frog and switch shops, and can be furnished for any type of current or voltage, and equipped with either hand wheel hydraulic, pneumatic or independent motor feed.

CAR VENTILATION.—Catalog No. 101 of the Railway Utility Company, 226 South La Salle street, Chicago, is devoted to the various types of car ventilators manufactured by this company. In addition to descriptions of the ventilators it contains a number of illustrations showing their application to both steam and electric railway passenger equipment.

CAR HEATING SUPPLY VALVE.—Circulars have been issued by the Gold Car Heating & Lighting Company, Whitehall building, New York, describing the packless quick opening supply valves with both single and double outlets which have recently been developed by this company for use in car heating systems. Sectional views of the valves clearly show the construction.

ELECTRIC INDUSTRIAL LOCOMOTIVES.—Descriptive leaflet No. 3,723 from the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., deals with the Baldwin-Westinghouse electric locomotives for industrial work. These locomotives are for use in industrial plants and on plantations as well as for hauling coal cars in power houses and other special work.

STORAGE BATTERIES FOR LOCOMOTIVES.—Bulletin No. 146, dated May, 1914, from the Electric Storage Battery Company, Philadelphia, Pa., is devoted to the Ironclad-Exide battery for storage battery locomotives. The bulletin contains 18 pages and includes a number of illustrations of locomotives fitted with this type of battery as well as descriptive matter, tables and diagrams.